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THE HISTORY AND WORK OF THE SARANAC LABORATORY FOR THE STUDY OF TUBERCULOSIS.[1]

BY E. L. TRUDEAU, M. D., Saranac Lake, N. Y.

GENTLEMEN :—I feel much as a scout, who had been doing duty alone on some frontier for many years, might feel when suddenly brought into the presence of a well organized army, and I assure you I appreciate the privilege of addressing you. I must apologize for talking of my own work, but the necessities of the situation make this more or less unavoidable. My experiences may prove an encouragement, perhaps, to those of you who are to locate at distant points, as demonstrating the possibility of doing scientific work in remote regions, far from the centres of learning, and they may prove of interest to a Society such as yours as describing the foundation of the first laboratory in this country devoted to researches in tuberculosis.

I had from the first many difficulties to contend with; no health, no scientific training, no apparatus, no access to books, and was situated forty-two miles from a railroad, in a primitive forest, where I had gone in search of health.

My inspiration was Koch's paper on the Etiology of Tuberculosis, of which I read an extract in a medical journal in 1883, and which was translated into English and sent me by a patient. In some of the short visits I was enabled to make to New York, Dr. Prudden taught me how to stain the bacillus, and the first principles of bacteriology, and I taught myself the rest as best I could.

My laboratory was a very small room in my house, in which, during the intense cold of winter, water generally froze at night, in spite of my best efforts, as we had no coal in Saranac Lake in those days, and the wood stove could not be counted upon to burn all night. I had no apparatus but my microscope. With Dr. Koch's paper as a guide, I succeeded, however, in growing the tubercle bacillus in a homemade thermostat, which had no regulating apparatus, and which was heated by a small kerosene lamp only. In order to protect this from the violent changes of temperature, which occurred principally at night, I had enclosed it in a series of wooden boxes, the doors of which could be opened

[1] Read before The Laennec, a Society for the Study of Tuberculosis at the Johns Hopkins Hospital, May 1, 1901.

or closed at will, according to the intensity of the cold out of doors. But on very cold nights I was obliged to get up in the night to make a fire in the stove in order to prevent too violent changes of temperature in my little oven.

With these primitive arrangements, after many failures, I obtained the tubercle bacillus in pure cultures, being, I believe, the second observer in America to do this; Dr. Sternberg, while himself located on the frontier, in a far distant military post, having succeeded in accomplishing this nearly a year before I did. With these cultures I repeated all Koch's inoculation experiments.

My guinea-pigs had to be kept in a hole under ground heated by a kerosene lamp, this being the only spot in Saranac Lake where they could escape freezing at night.

My first publication,[2] in 1886, was a record of experiments demonstrating the infectiousness of bacillary sputum, and the harmlessness of expectoration free from bacilli taken from a patient supposed to have consumption.

In 1886 I also studied the influence of extremes of environment on the course of inoculation tuberculosis, and published the results in a paper entitled "Environment and its Relation to Bacterial Invasion in Tuberculosis."[3] Many of my inoculated rabbits allowed to run wild on an island recovered, or developed only a localized disease, while those placed under the most unhygienic conditions I could devise, all died of tuberculosis within three months. The results of this research increased my confidence in the influence of a favorable environment on the course of the disease, and confirmed my faith in the value of the sanitarium and open-air method of treating tuberculosis, of which I was then making a practical application in the establishment of the Adirondack Cottage Sanitarium.

During the same week in which Koch's announcement of the discovery of tuberculin and of his hopes as to its specific curative action on tuberculosis, was flashed across the ocean and created in medical circles an excitement which has never been equaled, I published in the Medical Record[4] an article describing my attempts at the production of artificial immunity in animals by the injections of sterilized and filtered liquid cultures of the tubercle bacillus (tuberculin), and my failure to obtain any appreciable degree of immunity by this method.

Shortly after this time Dr. E. R. Baldwin came to Saranac Lake in search of health, and while at the Sanitarium began to help me with my experiments. How efficient a helper he has proved his own published work testifies, and the Laboratory at Saranac Lake owes much to his unselfish devotion to science.

About this time, while ill in New York, my house burned to the ground, the fire having originated during the night from the explosion of the kerosene lamp of the thermostat in my little laboratory, and everything in the house and laboratory proved a total loss. Two days after the fire I received from Dr. Osler a brief note, which shows that his great reputation should not be limited to his attainments as a physician, but that he may lay claim also to some reputation as a prophet. The entire substance of the note was as follows:

"DEAR TRUDEAU:—I am sorry to hear of your misfortune, but, take my word for it, there is nothing like a fire to make a man do the Phœnix trick."

Dr. Osler's prophecy very soon began to be realized. A friend and patient of mine, Mr. George C. Cooper, called on me the day after the fire, and after expressing his sympathy, told me that as soon as I was well enough he hoped I would return to Saranac Lake and build a suitable laboratory; one that could not burn down. That he wanted me to build the best I could plan for the purpose, and that he would pay for it. The photographs I show you illustrate how I availed myself of his generous offer.

The building is of cut stone, slate, glazed brick, and steel, completely fireproof, lit by electricity, heated by hot water, supplied with its own gas machine for the thermostats, Bunsen burners, and sterilizers, and furnished with every appliance for bacteriological and chemical work. It has a library which was donated by the late Mr. Horatio Garrett, of Baltimore, while the continuance of the experimental work so far has been made possible through the generosity of the late Mr. George Cooper, Miss Cooper, Mr. John Garrett, Mrs. A. A. Anderson, and others, who from time to time have given sums of money to defray the necessary expenses. It is purely a research laboratory, sells no products, and has now a legal standing, having been incorporated lately as the Saranac Laboratory, according to the laws of the State of New York. It has as yet no endowment, and is still dependent on the efforts of its founder for the funds necessary for its maintenance, but will, I hope, some day be endowed.

While the Laboratory was in process of construction a small addition to my stable was hastily built, and served as a temporary laboratory, in which for a year the work, thanks to the generosity of Mrs. Robert Hoe, was continued.

Much time was at first naturally enough devoted to the self-education of the staff of the Laboratory, to the study of the various culture-media proposed from time to time, and to perfecting our technic. A good deal of the work of the Laboratory has been given to testing experimentally all proposed specific methods of treatment and all consumption cures. The outlook, at first, seemed to tend toward the application of germicidal substances, and many experiments, which all proved barren of results, were made in this direction. We soon learned that the tubercle bacillus bore "cheerfully" a degree of medication which proved fatal to his host. We found that creosote, iodoform, sulphureted hydrogen, hydrofluoric acid, essence of peppermint, and other germicides proposed as cures, while they had no influence on the tuberculous process, often tended to shorten the lives of the treated animals. The publication of these researches, however, had some influence in disproving the claims of these

[2] American Journal of Medical Sciences, October, 1885.
[3] American Journal of Medical Sciences, July, 1887.
[4] Medical Record, November 22, 1890.

Saranac Laboratory for the Study of Tuberculosis. Built in 1894.

Interior of Saranac Laboratory for the Study of Tuberculosis.

specifics, and in preventing to a certain extent their more general application to the treatment of the human subject.

The next phase of our work was that which was devoted to attempts at the production of immunity by injections of sterilized attenuated cultures, and by the study on animals of the influence of treatment with toxines derived from the bacillus, and modified according to various methods proposed.

The claims made for the various tuberculins put forth by Koch, Hunter, and others, Klebs's antiphthisin and tuberculocidin, and Koch's T. R. tuberculin, as well as the different serums said to contain antitoxines capable of neutralizing the toxines of tuberculosis, were all tested in turn in many experiments, while for several years Dr. Baldwin and I, by various methods, attempted to produce a serum from rabbits, sheep, and asses, in which we could demonstrate the presence of antitoxine. Neither our serums nor any of those proposed by other experimenters were found capable of saving the tuberculous guinea-pig from a fatal dose of tuberculin.

At the time Koch published his paper on T. R. tuberculin, a study of some of the first bottles imported was made by Dr. Baldwin and myself, and demonstrated in this material the presence of living tubercle bacilli capable of infecting guinea-pigs, and enabled me to avoid the use of this substance at the time in the treatment of patients at the Sanitarium. No doubt the publication of our observations also prevented its general use until the defects in the technic of its manufacture had been remedied.

The tuberculin test and the mechanism of the tuberculin reaction have formed the subject of many of our studies, which have tended to demonstrate the reliability of the tuberculin test, and its apparent freedom from dangerous after-effects, and which have helped to throw some light on the mechanism of this reaction.

The studies made by Dr. Irwin H. Hance of the dust taken from all the buildings at the Sanitarium, showed that, with one exception (in a cottage in which a patient had been reported for expectorating on the floor), the dust tested was absolutely free from infectious properties, and this afforded experimental evidence that the methods adopted in the institution, to protect the patients from re-infection, were efficacious.

Dr. Baldwin has recently pointed out the possibility of infection of the hands of consumptives, and demonstrated the presence of living tubercle bacilli on the hands of patients using handkerchiefs, and their absence generally from the hands of Sanitarium patients who made use of the paper cuspidors.

Some of the papers published by my co-workers from the Laboratory have been as follows:

1. The Effect of Peppermint Inhalation on Experimental Tuberculosis. E. R. Baldwin. New York Medical Journal, May 18, 1895.

2. Effect of Antitubercle Serum in Experimental Tuberculosis. S. W. Hewetson. New York Medical Journal, Nov. 9, 1895.

3. A Study of the Infectiousness of the Dust in the Adirondack Cottage Sanitarium. Irwin H. Hance. Medical Record, December 28, 1895.

4. A Gift of Philanthropy to Science (The Saranac Laboratory for the Study of Tuberculosis). E. R. Baldwin. Scientific American, March 6, 1897.

5. Infection from the Hands in Pulmonary Phthisis. E. R. Baldwin. Philadelphia Medical Journal, Dec. 3, 1898.

6. Preliminary Communication on the Bio-Chemistry of the Bacillus Tuberculosis. P. A. Levene. Medical Record, Dec. 17, 1898.

7. A Case of Lymphatic Leukemia Combined with Pulmonary Tuberculosis. E. R. Baldwin and J. A. Wilder. American Journal of the Medical Sciences, June, 1899.

8. The Conditions of Tuberculous Infection and Their Control. E. R. Baldwin. Yale Medical Journal, March, 1900.

9. The Results of Sanatoria and Special Hospital Treatment in Pulmonary Tuberculosis. H. McL. Kinghorn. Montreal Medical Journal, July, 1899.

10. Some Retinal Complications in Chlorosis. H. McL. Kinghorn. Montreal Medical Journal, January, 1900.

11. Symptoms of Renal Tuberculosis. H. McL. Kinghorn. Montreal Medical Journal, March,1901, besides twenty papers by myself, the titles of which I will spare you.[5]

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[5] Publications by E. L. Trudeau, as follows:

1. An Experimental Research upon the Infectiousness of Non-Bacillary Phthisis.—Amer. Journal of the Med. Sciences, October, 1885.

2. Environment in its Relation to the Progress of Bacterial Invasion in Tuberculosis.—Amer. Journal of the Med. Sciences, July, 1887.

3. Hydrofluoric Acid as a Destructive Agent to the Tubercle Bacillus.—Medical News, May 5, 1888.

4. Hot-air Inhalations in Pulmonary Tuberculosis.—Medical News, September 28, 1889.

5. Some Cultures of the Tubercle Bacillus, Illustrating Variations in the Mode of Growth and Pathogenic Properties.—Transactions of the Assoc. of American Physicians, 1890.

6. An Experimental Study of Preventive Inoculation in Tuberculosis.—Medical Record, November 22, 1890.

7. The Treatment of Experimental Tuberculosis by Koch's Tuberculin, Hunter's Modification, and other Products of the Tubercle Bacillus.—Medical News, September 3, 1892.

8. Results of the Employment of Tuberculin and its Modifications at the Adirondack Cottage Sanitarium.—Medical News, September 10, 1892.

9. Eye Tuberculosis and Anti-tubercular Inoculation in the Rabbit.—New York Medical Journal, July 22, 1893.

10. A Report of the Ultimate Results Obtained in Experimental Eye Tuberculosis by Tuberculin Treatment and Anti-tuberculous Inoculation.—Medical News, September 29, 1894.

11. A Chemical and Experimental Research on "Antiphthisin" (Klebs). (By E. L. Trudeau and E. R. Baldwin.)—Medical Record, December 21, 1895.

12. Sanitaria for the Treatment of Incipient Tuberculosis.—New York Medical Journal, February 27, 1897.

13. The Tuberculin Test in Incipient and Suspected Pulmonary Tuberculosis.—Medical News, May 29, 1897.

14. The Need of an Improved Technic in the Manufacture of Koch's "T. R." Tuberculin. (By E. L. Trudeau and E. R. Baldwin.)—Medical News, August 28, 1897.

15. Remarks on Artificial Immunity in Tuberculosis.—British Medical Journal, December 25, 1897.

16. Experimental Studies on the Preparation and Effects of Anti-

Most of my own work has been devoted to the study of methods which might tend to produce artificial immunity, and has generally proved barren of definite results. All my attempts at inducing artificial immunity by the methods claimed by others to have been successful in immunizing guinea-pigs and rabbits were also negative. I learned by practical experience that toxine immunity and bacterial immunity in tuberculosis do not go hand in hand. While I could accustom my animals, by gradually increased doses at intervals, to bear without apparent injury, amounts of tuberculin and other toxic products of the tubercle bacillus which at first would have proved rapidly fatal, I found that this toxine immunization did not protect the animal against the invasion of his tissues by the bacilli when subsequently inoculated with them. The only observation I made from all this work which was in the least encouraging was obtained by preventive inoculations of cultures attenuated by many years of continuous growth on artificial media, and my results along these lines confirmed those of De Schweinitz.

By prolonged growth a culture is obtained which is not in the majority of cases fatal to rabbits, and only relatively so to guinea-pigs, many animals living over a year after the protective inoculation, and showing then only evidences of slight and localized tuberculosis. When reinoculated with virulent bacilli, guinea-pigs thus protected live about four times as long as the controls, though they all ultimately die. In rabbits thus vaccinated, and subsequently reinoculated with virulent tubercle bacilli, in the anterior chamber of the eye, the reaction produced by the virulent germs is very different from that noticed in the controls. In the controls, the introduction of the virulent bacilli in the anterior chamber produces at first little apparent irritation, and a couple of days later the eye shows no inflammatory reaction, and looks about normal. Little by little, however, tubercles begin to develop, and the conjunctival vessels become turgid, the cornea opaque, the intraocular pressure increases, and the eye goes on to more or less complete destruction. In the vaccinated animals, on the contrary, the virulent inoculation is almost at once followed by a violent inflammatory reaction, intense vascular congestion, and cloudiness of the cornea, which little by little subsides, at just the time when the eyes of the controls are rapidly getting worse. The tuberculous process in many instances seems aborted, and the eye restored, if not to its original integrity, at any rate with but little permanent destruction of the tissues involved. This does not take place in all animals, but in the greater proportion of them.

The encouraging feature of these results lies in the fact that some influence has been produced by the preventive inoculations (which usually are best made intravenously), so that the reaction of the tissues to the test inoculation is not the same as in the controls. This peculiar reaction of the tissues to the test inoculation would seem to be due to a certain degree of acquired immunity, as in other bacterial diseases in which artificial immunity can be produced, as in anthrax, we find a violent local reaction of the tissues in the vaccinated animals; a reaction which seems to abort the occurrence of general infection, while in the controls the local reaction is wanting, and the disease runs an uninterrupted course.

Throughout all these years, the results obtained in the Laboratory have been applied practically to the development and perfecting of the sanitarium treatment, and have given us a rational basis for the methods adopted there. The demonstration of the favorable influence of environment on the course of the experimental disease; of the actual protection from infection afforded by the methods adopted at the Sanitarium to this end; of the danger of hand infection by the handkerchiefs of consumptives; of the necessity of testing thoroughly, on animals, any specific method of treatment proposed before making use of it in the human subject, as evidenced by our experience with T. R. tuberculin; of the value of the tuberculin test in the detection of the disease, and its relative freedom from danger as shown by the experimental disease in animals, are all examples of the application of knowledge gained in the Laboratory, to the practical improvement of our methods of dealing with the disease in the human subject.

While the modern sanitarium represents the practical application of what we have learned and already know, the laboratory represents what we still hope to accomplish. It is to the laboratory and to research work that we must look if we are to advance in our struggle against tuberculosis; and the importance of forming such societies as yours, and of founding laboratories for research, where facilities for original work are at hand, and where, if need be, the living expenses of the workers may be defrayed, cannot, in my opinion, well be exaggerated.

In conclusion, allow me to bring to your attention, briefly, some of the more interesting researches as yet unpublished, which have been carried out at the laboratory this winter, principally by Doctors Levene and Baldwin, and which were made possible by the generosity of Mrs. A. A. Anderson.

Dr. Phoebus A. Levene, with the assistance of Dr. E. R. Baldwin, who furnished him with the enormous quantity of germs necessary for his chemical analysis, set himself the task of making what may be termed a chemical dissection of the tubercle bacillus. Much work on the chemistry of the tubercle bacillus has been done already by Behring, Hammerschlag, Hoffman, De Schweinitz, and Ruppel. As a result of Dr. Levene's work I show you in these flasks the various

toxins for Tuberculosis. (By E. L. Trudeau and E. R. Baldwin.)—Amer. Journal of the Med. Sciences, December, 1898, and January, 1899.

17. The Adirondack Cottage Sanitarium for the Treatment of Incipient Pulmonary Tuberculosis.—The Practioner, February, 1899.

18. The Present Aspect of Some Vexed Questions Relating to Tuberculosis, with Suggestions for Future Research Work.—Johns Hopkins Hospital Bulletin, No. 100, July, 1899.

19. The Sanitarium Treatment of Incipient Pulmonary Tuberculosis and its Results.—Medical News, June 2, 1900.

20. The First People's Sanatorium in America for the Treatment of Pulmonary Tuberculosis.—Zeitschrift für Tuberkulose und Heilstattenwesen, vol. 1, No. 3, 1900.

substances which he has thus far been able to isolate from the dried and crushed germs. The first flask contains a coloring matter, an alcoholic extract, of the washed, dried, and powdered bacilli. That this coloring matter is peculiar to the tubercle bacillus seems to be indicated by the fact that a few drops of it added to a glass of water give the same opalescent, yellowish green hue which is noticed in cultures growing on transparent liquid media.

He also separated a peculiar fat, or wax-like substance, which I now show you, and which forms thirty per cent. of the body substance of the bacillus. When the various component parts of the bacillus are stained, this is the only one which holds the stain in the presence of acids. It does not seem to be a toxine which causes the fever, since Dr. Baldwin demonstrated that animals inoculated with bacilli freed from fat react to tuberculin in the usual way.

Dr. Levene also separated three nucleoproteids which have different coagulation points. From these he obtained a nucleic acid, which I now show you, and which he found to contain more phosphorus than nucleic acid derived from other animal and vegetable substances which he tested. The nucleo-proteids of the tubercle bacillus are probably the toxic agent, or at least one of the toxic substances, contained in the bacilli. This was demonstrated in a set of experiments I will refer to again, where the toxicity of tuberculin was shown to be destroyed by those ferments which are known to be specially active in splitting up nucleoproteids.

Besides these substances, Dr. Levene found a glycogen, or a glycogen-like substance, which is contained in this small flask. This is the first time, to my knowledge, that this substance has been demonstrated in the tubercle bacillus, though the presence of carbohydrates has been suspected as a necessary source of energy.

He also studied the chemical differences in cultures grown on different media, in virulent and less virulent cultures, to determine the relation the chemical composition of bacteria might bear to their virulence. Comparative studies were made of bacilli grown on ordinary bouillon, and on a synthetic medium described by Proskauer and Beck, containing chiefly phosphates, mannit, and glycerin. Results show that more fat and a larger amount of proteid and free nucleic acid could be obtained from bouillon than from mannit cultures, and it would appear that toxic properties of bacillus are probably related to the nucleic acid and its combinations which they contain.

Another interesting set of experiments by Dr. Levene and Dr. Baldwin proved that the toxins of tetanus, diphtheria, and tuberculosis, are all destroyed by digestion with trypsin, and the first two by pepsin and papain also. When thus treated, tenfold fatal doses were harmless. Tuberculin could not be destroyed entirely by peptic digestion, and it is probable from this fact that it is a nucleo-proteid, this group of proteids being more resistant to pepsin.

THE PREVENTION OF TUBERCULOUS DISEASES IN INFANCY AND CHILDHOOD.[1]

BY S. A. KNOPF, M. D., New York City.

Before entering my subject I desire to express my most heartfelt thanks to your Professors, Welch and Osler, who honored me with the invitation to deliver these lectures before you. To lecture to an audience composed of students and the post-graduate class of Johns Hopkins Medical School, which to-day stands as an example of what is understood to be the highest type of the medical department of a university, not only in this country but also abroad, is a privilege which, I assure you, I appreciate most highly.

As the title of my address indicates I have chosen to discuss before you to-night the Prophylaxis of Tuberculosis During Childhood. The importance of this subject I hardly need to emphasize, for the prevention of tuberculosis in children is one of the most essential factors in the solution of the tuberculosis problem.

You know of the prevalence of this scourge in the human race. Everyone of you knows some family in which one or several members are suffering from this disease, and others in which for two or three generations it has been considered the family affliction, are not rare. The members of those unfortunate families are very often spoken of as having inherited consumption or phthisis pulmonalis.

Let us, for a moment, summarize what we really know of a direct hereditary tuberculous disease. Bacillary transmission, coming directly from the paternal side through sperm, has been experimentally demonstrated. Clinically, however, the cases are exceedingly rare. According to Lartigau[2] there are only four reported cases, and even in these it was possible that there was hereditary predisposition with subsequent bacterial infection. Benda thinks spermatozoa incapable of transporting immotile bacilli. Walter[3] examined microscopically 230 different preparations from testicles and 63 from prostate glands, coming from 21 patients who had died of pulmonary tuberculosis, and could not find a single bacillus in any one of them.

The extreme rarity of primary genital tuberculosis in vagina or uterus seems the best clinical evidence that direct

[1] Lecture delivered before the Senior and Post-graduate Classes of Johns Hopkins Medical School, May 28, 1901.

[2] "Congenital Tuberculosis," Twentieth Century Practice of Medicine, vol. xx.

[3] Cornet, "Die Tuberkulose," Berlin, 1899.

paternal bacillary transmission of tuberculosis practically does not exist.

Maternal bacillary transmission, on the other hand, can take place through the placenta and perhaps even through the ovum. Forty such cases of indisputable congenital tuberculosis traceable to maternal origin are now on record. This number, however, is infinitesimally small compared with the number of authentic cases where the child of a tuberculous mother has been carefully examined without finding the slightest trace of tuberculous disease, either clinically, bacteriologically, or pathologically.

Straus,[4] who has made extensive experiments in this direction, repeatedly transplanted portions of the various organs of a fetus from a mother in the last stages of consumption into guinea-pigs and never succeeded in producing tuberculosis in these animals. Von Leyden[5] failed likewise in his experiments to inoculate tuberculosis with organs taken from a child which had died a few minutes after birth and which had a consumptive mother. Noccard,[6] who only experimented with animals, took the organs of 32 fetuses from four tuberculous rabbits and eight tuberculous guinea-pigs, and inoculated 32 guinea-pigs, all with negative results.

Thus it seems to us that we might consider direct bacillary transmission, even from the maternal side, so exceedingly rare as to leave it outside of consideration in studying how to prevent tuberculosis in childhood. Let us rather assume two cardinal points; first, that tuberculous infection contracted in whatever way during infancy or childhood comes from without and not from within. Secondly, that there may, however, exist a hereditary predisposition to tuberculosis. How this predisposition is brought about I do not wish to attempt to explain. It is, however, I believe, reasonable to suppose that the toxins secreted by the bacilli in the lungs of a tuberculous mother and the general debility caused by them, impair often quite seriously the development of the child *in utero*.

As to the frequency of tuberculosis in childhood I will not burden this little address with many statistics. Permit me only to quote a few of the more interesting ones. Bollinger[7] in 500 autopsies of children of all ages up to the fifteenth year found lesions of tuberculosis in 218 cases. In 150 of these the lesions were active and in 68 latent.

As to the time when children manifest the symptoms of tuberculosis most frequently, Heubner's[8] statistics are instructive. Of 844 infants of which none suffered from tuberculosis at the time of their reception in the hospital, the development of the disease took place in 3.6% at the age of 3 to 6 months, in 11.8% at the age of 9 months, in 26.6% at the age of one year.

Of 458 children 14.2 % were found tuberculous at the age of 2 years.
" 376 " 13.4 " " " " " 3 "
" 306 " 11.1 " " " " " 4 "
" 470 " 7.4 " " " " " 5-6 "
" 682 " 5.0 " " " " " 7-10 "

Let us incidentally remark that even these statistics seem to prove that children are very rarely born tuberculous. We know from animal experiments that the grosser pathological changes, brought about by the bacillus of tuberculosis, such as enlargement of the glands, are not produced before two or three months after the penetration of this micro-organism into the system.

According to Küss[9] the maximum death rate from tuberculous lesions in childhood is reached between the second and fourth years. As to the modus operandi of the infection of children we have, of course, no statistics. To ascribe the very frequent intestinal tuberculosis found in childhood exclusively to a tuberculous milk supply would be unscientific. There is no doubt that many a child has been rendered tuberculous because of taking food coming from tuberculous cows, but in as many, perhaps even in more cases, intestinal tuberculosis is secondary and has resulted from the ingestion of pulmonary secretions, since small children never expectorate. Autopsies seem to show that a very large percentage of children have contracted tuberculosis by inhalation since the bronchial glands harbor the oldest foci and seem thus to represent the point of entry of the tuberculosis bacilli. The presence of bronchial and pulmonary foci and tuberculosis of the mesentery glands, when all lesions seem to be of the same duration, may well be explained by a double infection of the respiratory and alimentary tract of the child.

A more recent explanation of the frequent presence of tuberculosis in the bronchial glands as being also probably due to the ingestion of tuberculous milk, is given by Latham.[10] According to this author the bacilli pass from the intestinal mucous membrane, by way of the lymphatics, to the bronchial glands. From these glands the process spreads to the lung tissue, 1, by direct continuity; 2, by means of the lymphatics but against the supposed lymphatic stream; 3, by ulcerating into a blood-vessel and in this way disseminating the bacilli all over the body; and 4, by ulcerating into a bronchus. The right set of glands is more commonly affected than the left. Latham, whose observations cover more than 3000 cases, admits, however, a very frequently infected air supply as a cause of tuberculosis in childhood. Thus we see that in young as well as in old, tuberculous infection can take place in three ways, namely, Inhalation, Ingestion and Inoculation.

The presence of a consumptive who is careless with his expectoration is sufficient to endanger the life of a child; and it is not at all necessary that the child should come in close contact with this individual. Heubner speaks of num-

[4] Straus, "La tuberculose et son bacille."
[5] Zeitschrift f. klin. Medicin, Bd. viii, 1884.
[6] Annales des med. exp., vol. i, 1889.
[7] D'Espine, Annales de med. et de chir. infantile; September 1, 1900.
[8] "Zur Verhütung der Tuberkulose im Kindesalter," Congress of Tuberculosis, Berlin, 1899.
[9] Küss, "De l'Hérédité parasitaire de la tuberculose humaine," Paris, 1898.
[10] Latham, "Pulmonary Tuberculosis in Early Childhood," Lancet, December 22, 1900.

erous cases where children from healthy parents given into a family to board became tuberculous owing to the presence of a consumptive in that family.

The sputum coming from a tuberculous mother, father, relative or friend is a very frequent cause of the infection of little infants. Here the infectious germs may be ingested by the child with its saliva, but being kissed by tuberculous individuals is not the only source of the ingestion of tuberculous saliva. Midwives and sometimes also physicians will in the presence of an asphyxiated newborn child apply their mouth to that of the infant and inflate the child's chest to bring its respiratory organs into play. If the operator is consumptive the danger of imparting his or her disease to the infant is evident. In my recent book on tuberculosis [11] I quoted the remarkable case of Reich, which, I believe, will bear repeating here as an illustration: A midwife in the village of Neuenberg became consumptive in 1874, and died of this disease in July, 1876. Ten children, without hereditary predisposition, attended by this midwife between April, 1875, and May, 1876, died before reaching the age of seventeen months. This consumptive midwife was in the habit of sucking the mucus from the mouths of newborn children, and blowing air into their mouths when there was the slightest sign of asphyxia.

I was assured by a tuberculous mother that since the family physician had warned her never to kiss the child on the mouth, she had religiously refrained from doing so; but while telling me of this devotion I saw her tasting the food she was preparing for the child, to judge of its palatability and temperature, from the same spoon with which she fed her infant. In like manner the rubber nipple of the milk bottle may also become a source of infection.

Inoculation during early infancy is relatively rare, if we leave aside the comparatively numerous cases of tuberculous infection through ritual circumcision. I have been able to collect about twenty authentic cases, but the surgical literature of all countries where Israelites practice this rite in the orthodox way, continues to contain reports now and then of cases of tuberculous infection through this mode of circumcision. The tuberculous inoculation following this operation manifests itself first as a local disease of the genital organs from whence it becomes generalized in a great number of cases. The operation of circumcision, when skillfully and carefully performed, is in itself trifling, but the sucking of the prepuce afterwards makes it dangerous, for it is evident that if the operating rabbi should be a consumptive, inoculation is made very possible.

So much for the dangers to which the infant is exposed. When the child becomes old enough to creep about and play on the floor it is exposed to all three methods of infection at once. If there is a consumptive in the family and he is careless, ignorant or helpless, there will be ample opportunity for the little one playing on the floor to inhale the dust laden with bacilli, coming from the pulverized and dried expectoration. Like all children it will touch everything on or near the floor and then put the fingers into the mouth. To conceive of a more certain method of ingesting tuberculosis is hardly possible. If the child's nails are not clean and closely cut it will inoculate itself with tuberculous substances. This method of infection happens quite often, particularly when the child is suffering from eczematous or other skin troubles. The result may be a local tuberculosis, or, perhaps, more frequently a lymphatic infection. To relieve the itching sensation produced by the irritating nasal secretions of a coryza, the child will poke its fingers into its nose and we may have there the starting point of a facial lupus. Older children are exposed to the same causes of infection, though perhaps in a lesser degree, when playing in public or private playgrounds, kindergartens, etc. That the infection of a child attending school from other tuberculous children of the same class, or even from a consumptive teacher, is possible, we must admit, especially in schools where the hygienic conditions are poor and where no sanitary supervision exists.

What remedies have we to suggest to counteract these multiple dangers to which children are exposed from the ever present bacillus tuberculosis?

To assure a rigorous prophylaxis against tuberculosis from the very earliest day of childhood I do not know of any better plan than to have printed directions issued by the boards of health, which should be in the hands of every physician and midwife to give to the future mother, to the nurse or the immediate members of the family. These instructions should contain everything relating to prophylaxis, general cleanliness, ventilation, nutrition, etc. The leaflets should be printed in plain, comprehensible language.

While it is now the almost universal practice never to let a child be nursed by a tuberculous mother, for the sake of preserving the strength and the life of the mother, prohibiting the tuberculous mother to become the nurse should also find a reason in the interest of the child. A tuberculous mother may transmit tuberculosis to the child through her milk.

While separating a child from the tuberculous mother and giving it the best hygienic and sanitary environments elsewhere, would be the ideal way of solving the problem, it is but rarely practicable. We must find means to protect a child in its own home. To avoid the inhalation of tuberculosis the greatest care should be exercised on the part of parents, relatives or friends with whom the child lives. The well-known precautions concerning the tuberculous expectoration, and also drop infection, that is to say, the ejection of small particles of bacilliferous saliva during the so-called dry cough, loud talking or sneezing, should be rigorously adhered to by everyone who may come in contact with the child. The child should not sleep with a tuberculous mother. It should have its own little bed from the day of its birth. The child should never be taken on visits to consumptive friends or relatives.

[11] Knopf, "Pulmonary Tuberculosis: Its Modern Prophylaxis and the Treatment in Special Institutions and at Home". P. Blakiston's Son & Co., Philadelphia, 1899.

As a matter of course, if a child should be removed from the parents' home and be boarded elsewhere, one should be sure that there is no consumptive in the new home of the infant, and that it is not frequented by consumptives. Day nurseries or infants' shelters where working women often leave their infants should be subject to thorough sanitary supervision and no tuberculous individual should be employed in such an establishment. In choosing a wetnurse or simple attendant to a child one should always assure oneself of the absolute health of the individual.

To combat the danger from ingestion of tuberculous cow's milk is, of course, primarily a duty which devolves upon sanitary authorities, the State, county, or city boards of health respectively. It is the duty of these authorities to make the sale of tuberculous milk practicably impossible. But to all mothers who do not nurse their children it should become a religious duty to boil or sterilize the child's milk, particularly in cities where one is never certain of the absolute purity of that article. Whenever it is possible cow's milk should be replaced by goat's milk, which, as is well known, is almost never tuberculous. When the child grows older and eats meat, all that is of doubtful origin should, of course, be thoroughly cooked.

To kiss the child on the mouth should not be allowed in any case, and as the child grows older it should be taught not to kiss strangers at all and relatives and friends only on the cheek. Caressing and kissing domestic pets, such as parrots, canary birds, dogs, cats, etc., should be discouraged.

Since we have spoken of the possibility of midwives or physicians infecting the newborn child in the attempt to bring its respiratory organs into play, we will also suggest a remedy. To avoid such accidents the mouth-to-mouth respiration should be replaced by the safer method of using the catheter, as recommended by Tarnier and Lusk. Laborde's method of rhythmical traction of the tongue will also suffice to cause the child to breathe if the obstructing mucus has been removed. A simple swab suffices to remove this mucus, and to do this by mouth-to-mouth suction is to be condemned.

The bottle and nipple through which the child receives its milk should be kept scrupulously clean, and the tuberculous mother should never put the nipple into her mouth. Later on, when the infant is old enough to be fed with a spoon she should again bear in mind that her own saliva is likely to be bacilliferous and she should avoid using the same spoon for herself and child. The remnants of food left by a tuberculous invalid should not be eaten by any one, but more particularly not by a child, neither should the latter eat any food handled by a consumptive.

Inoculation of tuberculosis of an infant through the orthodox rite of circumcision will be difficult to combat by a simple protest against this operation on the part of physicians, although it is well known that syphilis and diphtheria have also been transmitted through this suction process, and that through lack of skill in after treatment, secondary hemorrhage, erysipelas and gangrene having ensued, orthodox Hebrews will rarely permit any modification in this procedure. I would therefore suggest as a remedy that only such persons should be allowed to perform circumcision as have shown the necessary skill before a medical board of examiners, and that every time they are called upon to perform the rite they should submit themselves to a medical examination. Only when bearing a certificate from a regular physician, stating the absolute freedom from specific diseases, should they be allowed to perform ritual circumcision.

As another reliable prophylactic measure against the possibility of inoculating the child when the parents insist upon the orthodox method of circumcision, is the suction by the aid of a glass tube, as practiced in France and Germany.

So much for the measures to protect the infant during his earliest age from the possibility of infection in the three ways, inhalation, ingestion, and inoculation. We will now see what can be done in the line of prophylaxis for the child who creeps on the floor, learns to walk, visits kindergartens, plays on public or private playgrounds, visits menageries, and finally goes to school.

The floor of the rooms where the child lives and on which it plays should not be carpeted. It should be kept scrupulously clean and, if desired, a clean mat may replace the carpet. To keep the ordinary wooden floor clean and as far as possible aseptic, the use of petroleum wax as recommended by R. Petit[12] should be endorsed. Experiments have demonstrated that the various pathogenic microbes, such as the bacillus of diphtheria, of typhoid fever, the streptococci and staphylococci, and the bacterium coli, can not live in this substance, and the tubercle bacillus loses its virulence when in contact with it. The cracks in the floors should be filled and also covered with this substance. Water and even antiseptic substances do not alter this wax. The ordinary broom should never be used in cleaning children's rooms; if wiping the floor is not practicable it should be swept with moistened sawdust. All these precautions recommended for the children's rooms in the private home should, of course, be practiced if possible even with more rigor in public nurseries, kindergartens, asylums, orphanages, etc.

In view of the possibility of infecting any room by drop infection it is best that the consumptive, even if ordinarily careful with his expectoration, should sojourn as little as possible in the children's rooms. Of course, it goes without saying that neither spitting nor smoking should be allowed in children's quarters. Expectorating on or near public or private playgrounds should be considered a misdemeanor and punished accordingly. These grounds should be kept specially clean and from time to time be strewn with clean gravel.

The greatly loved visits of little ones to menageries must be of concern to the sanitarian who desires to protect the children from tuberculosis. To visit the ape house in the zoological gardens and to remain there as long as possible is

[12] "Récherches sur un procédé simple pour aseptiser les planchers," Congrès de la Tuberculose, 1898.

the delight of children, and yet, perhaps next to cattle there are no animals so subject to tuberculosis as apes. Add to this the commotion, dust, and impure air in the average ape-house at the usual time of the children's visits, and one cannot help thinking of an absolute danger. The managers of menageries and zoological gardens should do their very best to reduce this source of infection to the least possible minimum. A tuberculous keeper might very easily infect the animals under his care, especially since their confinement makes them particularly susceptible to the invasion of the bacilli. The law which authorizes the killing of tuberculous cattle should be extended to all other animals as well. There seems no reason why an ape house, containing numerous consumptive animals, should not be as much a source of infection as a tenement house where ignorant or careless tuberculous individuals have expectorated indiscriminately. Expectorating on the floor or anywhere else in these menageries should be strictly prohibited to keepers as well as to visitors, and the floor should always be strewn with moistened sawdust during visiting hours.

The hygiene which should prevail in the kindergarten and playroom should, of course, also be universal in the school-house. School children should be taught the use of spittoons and handkerchiefs. Expectorating anywhere except in a proper receptacle should be punished in the same way as any violation of class rules. The elevated non-breakable spittoon should be given preference to the ordinary porcelain or glass cuspidor placed on the floor. I have often wondered if the individual pocket flask in the public school would not also tend to decrease epidemics of hiccoughs, measles, and grippe, besides being one of the best means of preventing the contraction of tuberculosis through indiscriminate expectoration. Each child should have a cupboard where he should keep his own towel and drinking-cup. To avoid drop infection, children should be taught to always hold a handkerchief before their mouth while coughing or sneezing.

Obligatory periodical disinfection of the schoolroom by formaldehyde gas may also be advantageously instituted. To make the disinfecting and cleansing of the classroom as thorough as possible, I would suggest that desks and chairs be so constructed that they can easily be folded together after school hours. This innovation in school hygiene was first inaugurated by School Superintendent Akbroit, of Odessa, with most satisfactory results. As another sanitary measure I would insist that lady school teachers and the grown-up girl pupils should not under penalty of discharge, be allowed to wear trailing dresses. The short rainy-day skirt is, in my humble opinion, most becoming to teachers and pupils, and certainly far more sanitary than the trailing skirt which so often is made to do the scavenger's dirty work.

The fundamental principles of hygiene, especially in regard to the prevention of tuberculosis, should be made part of the curriculum in every class. I was told by Dr. Roger S. Tracy, of the New York Board of Health, that there existed in some town out west, the name of which he had forgotten, the custom of inclosing a leaflet for the teaching of hygiene in every book belonging to the school. Now, it seems to me that this is an excellent idea and a good way to teach the fundamental principles of general hygiene and particularly the prevention of tuberculosis, and I would strongly recommend this plan to all our boards of education.

Kissing, which is such a prevalent practice in some girls' schools, should be discouraged and designated as unhygienic. While children suffering simply from scrofulous manifestations might be permitted in public schools, all pupils suffering from pulmonary tuberculosis, or teachers afflicted with the same disease should not be allowed there.

The early recognition of pulmonary tuberculosis, which is so essential in the solution of the tuberculosis problem in the adult, is equally important in regard to the combat of this disease in childhood. Here comes a function of the school physician (and no school should be without one) which, I believe, has not as yet been sufficiently appreciated nor exercised. The chest of every child attending the public school and every teacher teaching there should be carefully examined at least twice or three times a year, if owing to a large number of pupils this can not be done every three months. Through the early discovery of tuberculosis in a pupil, an immediate warning to the parents, and timely and judicious treatment many a young life will be saved.

To prevent an inoculation tuberculosis during the time the child is likely to play on the floor, mothers and nurses should see that the child's fingers are kept as clean as possible and his nails cut. As long as the child is too small to clean its nose, regular nasal toilets with some mild borated solution or warm previously boiled water should be instituted. Eczemas and other skin eruptions should receive immediate medical attention, for, as has been said, left to themselves they may give entrance to tuberculous infection.

We come now to the second portion of our discourse, which treats of the hereditary disposition which the child of tuberculous parentage possesses at birth. We may define this hereditary disposition in two ways. As bacteriologists we would probably say a hereditary predisposition is that peculiar condition whereby the various organs, and in particular the respiratory and next to it the intestinal tract, offer a very favorable soil or culture medium for the development and multiplication of the bacilli. As clinicians we might say hereditary predisposition to tuberculosis means a physiological poverty, brought as an inheritance into this world, whereby the system is minus phagocytic and bactericidal powers inherent in strong and healthy organisms.

It is well known that the transmission of a tuberculous tendency comes most frequently from the maternal side. The most radical means of preventing a progeny subject to tuberculosis would, of course, be the interdiction of marriage to all tuberculous individuals. Our present state of society and our conception of individual liberty will scarcely make it possible for the time being, to inaugurate legislative means to counteract marriages between tuberculous individuals. General education and enlightenment on this question may be helpful as a prophylactic means, but the family physician will have to do the bulk of the work in preventing such dangerous unions. Even the cured consumptive should not think of marrying until a considerable time after his complete restoration to health. Gerhardt[13] counsels to wait at least one year, but I consider this hardly enough and would much rather make it two years.

To bring about abortion when a conception has taken place in a tuberculous mother I consider useless. Instead of saving one life there is the danger of sacrificing two; but in view of our present knowledge of tuberculosis I have no hesitation to declare that I do not consider it a sin either before God or man to instruct a tuberculous mother or father that they may not procreate a tuberculous issue. If, in spite of the warning of the family physician, a tuberculous mother has conceived, what are we to do? Shall we leave the mother and child to their fate? Surely not! Though the mother may be suffering from tuberculosis and the child seemingly be doomed to become a candidate for consumption, modern therapy has taught us not to despair, and we may save the lives of both; but we must begin by treating the child *in utero* and with this, of course, begin a thorough treatment of the mother's condition, and continue it at least a year after confinement. A woman who is to give birth to a child should abandon the corset and tight clothing in time to allow a continued, free abdominal and thoracic respiration. Better yet is it if she has never been addicted to the habit of tight lacing, for the experiments of Kellogg[14] and Mays have demonstrated that the so-called female or costal type of respiration which prevails among civilized women is the result of their restricting and unhygienic mode of dress, and is not due to the influence of gestation or to a natural difference in the anatomy and physiological growth of man and woman. If a support for an unusually large breast must be worn let the corset be replaced by a comfortable waist which permits free and deep respiratory movements. Instead of tying her skirts around the waist she should wear them suspended from the shoulders. By wearing a close-fitting union-suit for underwear of wool or cotton, according to the season, it will be possible to get along with less skirts and thus lessen the weight around the waist. In short, the whole dress of the mother should be so arranged that there are no restrictions and that no organ in the body should be hindered in its free physiological functions. For the future mother to live as much as possible in pure, fresh air, to take frequent breathing exercises, to avoid crowded assemblies where the air is vitiated, to live, in short, as hygienic a life as the family's social condition will permit, will have a most salutary effect on the child's health. If the circumstances are such that you can induce this family with a tuberculous mother, living in the city, to move to the country or to a smaller town where modern hygienic conveniences can be had, but where the crowded and noisy conditions of city life are absent, so much the better for the prospects of mother and child.

The newborn babe is in need of pure, fresh air as much as the mother; and the lying-in room and the nursery should always be well ventilated. When in due time the child is taken for an airing, the thick, almost impermeable veil should be abandoned. These veils, often tightened around the little face, press against the nose and make it difficult for the

[13] "Ueber Eheschliessungen Tuberkulöser," Zeitschr. f. Tuberkulose u. Heilstättenwesen, September, 1900.

[14] Kellogg, "Experimental Researches Respecting the Relation of Dress to Pelvic Diseases of Women", Transactions of the Michigan State Medical Society, 1888.

child to breathe naturally, yet the mother wonders how the baby got into the habit of breathing through the mouth.

Frequently also, mouth-breathing in children, and sometimes in adults, must be attributed to adenoid vegetation in the nasopharynx, or to enlarged tonsils. These as well as all other causes of obstruction to a free, natural respiration, such as deviated septum, enlarged turbinated bones, hypertrophied mucous membrane, polypi, etc., must be removed if we desire to protect the child or adult from chronic nasal, pharyngeal, or laryngeal catarrhs, so often the forerunners of pulmonary disease.

The proper bringing up of children that have a tendency to become tuberculous is of the greatest importance. Many are poor eaters from the day of their birth. Discipline, not to allow too many sweets, to observe regular meal-times, and to keep the bowels in good condition, are the best means to combat a dislike for eating. As early as possible children should be taught to clean their teeth thoroughly after each meal, for a good digestion is dependent upon the good state of the teeth. The dislike to play outdoors, which is so characteristic of the little candidates for tuberculous diseases, can also only be overcome by discipline. To dress them too warmly and bundle them up all the time is as injurious as having them remain most of the time indoors. This hardening of the constitution will be the best method to counteract a disposition to take cold easily, which in children predisposed to tuberculosis has often a tendency to develop catarrhs of the deeper respiratory tract.

I consider the air-bath and sun-bath for children at the earliest age most beneficial. Let the little ones toddle around naked every day for a short time; in cold weather in well-warmed rooms, and in summer in a room bathed by the rays of the sun, but always on a clean floor or clean Japanese matting. With their growing intelligence children should be taught by practice and example the value and the love of pure, fresh air. As soon as the age and intelligence of the child will permit, breathing exercises should be taught him. He should learn to like them as the average child does general gymnastics.

The lying-in room, the nurseries and playrooms must always be well ventilated. Public as well as private schools and colleges should be model houses in regard to cleanliness, hygiene and constant ventilation. Ventilation not only when the children have left, but all the time, and, as Emmert[18] says, since windows and doors alone do not suffice to properly ventilate rooms when occupied by a mass of human beings, mechanical devices should be resorted to to secure always a plentiful supply of fresh air. Overwork during school life is an indirect cause of furthering a tuberculous tendency in many children, and indeed it is injurious even to a healthy child. Much out-door play, singing and reciting in the open air should be encouraged. This life out of doors, the love for pure and fresh air, for gymnastics and out-door sports should be kept up by the young man and girl leaving school throughout life.

In choosing his future career the young man born with that peculiar susceptibility which Peter describes so aptly as "*tuberculisable*" should seek professions which will demand out-door life. Farming, gardening and forestry will assure him the longest and most useful existence.

Hydrotherapeutics, as a measure to prevent pulmonary tuberculosis, tends to develop to more vigorous action the vasomotor system; it also should be instituted at an early age. A child, a few months old, can support with impunity a rapid sponging off with cold water after its warm bath, followed by a relatively vigorous friction with a soft Turkish towel. As the child grows older he should not only be taught this use of cold water after his semi-weekly or weekly warm bath, but he should wash at least the face, neck and chest every morning with cold water. Better yet, if he can accustom himself early to a daily cold douche. The utility of all-the-year-round swimming baths, where old and young of all classes can, gratuitously or for a moderate price, enjoy the salutary effects on body and mind of a good swim, is too well known to need to be insisted on.

There should be many small parks and playgrounds and public baths for old and young in the densely crowded districts of our large cities. City parks have justly been called the lungs of great centers of population. Here mothers and children of the poor can breathe purer and fresher air, which is one of the best means of preventing tuberculosis.

I have thus far but slightly touched on the sociological side of prophylaxis. I have not made much distinction between scrofulous and tuberculous diseases, for the former is but a lighter form of tuberculosis. The same sociological conditions which further tuberculosis in the pulmonary form further also scrofulous diseases. Children from syphilitic and alcoholic parents are particularly prone to tuberculous and scrofulous affections. In seeking to prevent tuberculous and scrofulous diseases in childhood we must combat our two great social evils, syphilis and alcoholism.

Here I cannot help also denouncing strongly the employment of children under fourteen years of age in various industries requiring often six to ten hours of continued manual labor, and often in factories and mines where work even taxes the healthy organs of a full-grown man.

Of the frequency of scrofulous and tuberculous troubles among children of the poor one has scarcely an idea. In one of the public schools of Berlin, where careful statistics are kept concerning the daily attendance of the children, it was found that out of 125 boys and 132 girls who did not attend school regularly, not less than 112 of the former and 115 of the latter suffered from tuberculous or scrofulous troubles. As to what is best to do for the underfed pupils, the children of poor parents, attending our public schools, I would suggest a philanthropic enterprise which would cost little and which would do a world of good. Provide them with a lunch of a few good meat sandwiches and one or two glasses of good milk, and I am convinced that fewer

[18] Emmert, "Is Our Public School System Conducive to Tuberculosis?" Transactions of the Iowa State Med. Society, 1898.

will develop tuberculosis and scrofulosis, and they will do better work at school and at home. A similar experiment has been tried recently in one of the German schools for the poor, and the results have been most gratifying; nearly everyone of the children gained in weight and strength in a relatively short time.

For children suffering from either tuberculous or scrofulous manifestations the treatment is well known. Codliver oil, arsenic, iron, but above all hygienic and dietetic measures, aero-, hydro- and solar therapy, under constant medical supervision in a good healthy locality, preferably in sanatoria erected for that purpose in the country or on the seashore, have proven to be the most efficacious means to treat these diseases during childhood. With so many beautiful places in our inland and seacoast towns, which would be suitable for children's sanatoria, it is to be regretted that we have almost no such institutions as yet. In France, Germany, Holland and Italy there exist numerous children's sanatoria for the treatment of tuberculous and scrofulous diseases. To these are attached splendid schools so that the intellectual side of the children's training is not neglected. The results obtained in these institutions for the little sufferers are even better than those for adults, the latest reports giving as much as 50 to 75% of complete cures.

Under medical news from Colorado I read in last week's Journal of the American Medical Association (May 18th), that by order of State Health Commissioner Clough, promulgated April 15th, sufferers from tuberculosis are excluded from public schools. This means, of course, an exclusion of tuberculous pupils and teachers alike. But, I ask, has the State of Colorado provided another place of instruction for these little ones? Is it just to exclude a child from public school for so long a time as the cure of such a chronic disease as tuberculosis must of necessity require? The action of any health authority in suppressing tuberculosis in public schools should be commended, but before enforcing the regulations which deprive the child of the right and privilege of education, those authorities should see that specially constructed sanatoria-schools should be erected where these little ones receive not only the benefit of judicious medical treatment and practical hygienic training, but also that school education to which every American child is entitled.

There is a strong awakening now for the need of sanatoria for consumptive adults throughout the United States. Let us in our eagerness to treat the consumptive man and woman not forget that to treat tuberculous and scrofulous children is just as important. These special children's sanatoria, situated on the seacoast or inland in particularly healthy localities, are powerful agents in the prevention and cure of tuberculosis. By carrying out the prophylactic measures which I endeavored to outline in the first portion of my lecture and by providing institutions for children already afflicted with tuberculous or scrofulous diseases, we will prevent many a one from becoming a consumptive man or woman. Through prevention and timely cure these little ones have many chances to become strong, healthy and useful members of the community. Let us take good care of the little children and never forget that the child of to-day will be the man of to-morrow.

16 West Ninety-Fifth Street.

RESPIRATORY EXERCISES IN THE PREVENTION AND TREATMENT OF PULMONARY DISEASES.[1]

By S. A. Knopf, M. D., New York City.

I have chosen this subject for the second lecture which I have the honor to deliver before you, in the hope that it may result in some practical good, not only to your patients, but also to yourselves. We as physicians are very apt to neglect our own health. Often deeply absorbed in our work we forget, for example, to take our meals regularly; or we eat hastily, and do not rest when we ought to rest. The general practitioner, and the majority of us are general practitioners, is the greatest sinner in this respect. We will often scold the members of the families, whose physicians we may be, if we discover them to be neglectful in these matters so essential to a healthful life, and still every day we are doing the very things which we tell them not to do.

I believe this is a good opportunity to sound a note of warning. I have the honor of addressing physicians older than myself, some of my age, and some a good deal younger. Of the older ones I must ask pardon for trying to teach them what they know better than I, but what I know they only teach to others and rarely practice themselves. These, my seniors, I will only remind what a good thing it would be for their own welfare to practice as regularly as possible what they preach so frequently. To my colleagues and younger friends I will say, preach regular living to your patients and practice it yourselves. As a rule take your meals regularly, irregularly only as an exception. Take time for your meals and only eat hastily when it must be done. Never start out to work with an empty stomach. Get eight to nine hours sleep out of every twenty-four; if not possible to have it in one stretch, take this time, necessary for recuperation, in installments. Eight hours of sleep, regular meals, good nutrition, good digestion, and proper assimilation of our food are, however, not more important to our well-being and that of our patients than good air and proper

[1] Lecture delivered before the Senior and Post-graduate Classes of Johns Hopkins Medical School, May 29, 1901.

breathing. The natural man breathes physiologically; but civilization with the many blessings it has conferred upon us has also brought to us certain customs in the shape of dress, habitation, and occupation, which interfere with the natural process of breathing, on one hand by restricting our thoracic and abdominal organs by uncomfortable dress or peculiar posture, and on the other by placing us in environments which make it impossible for us to get constantly a sufficient amount of fresh, pure air.

Let us first try to define what natural breathing is. While air may enter the respiratory tract of man through the mouth when he is speaking, for the greater part of his existence he should breathe through the nose. The nose is the natural organ for the entrance of air. Its osseous conformation and its lining, the Schneiderian membrane, have the function to protect the deeper respiratory tract from foreign and irritating substances, and to render the cold air inspired warm enough not to be injurious to the delicate pulmonary structure. The first requisite then for good natural breathing is a nose free from all obstructions. Spurs, a deviated septum, polypi, or a marked hypertrophy of the mucous membrane, adenoid vegetations, in short, whatever prevent the air from passing freely through the upper respiratory tract, are a hindrance to the natural respiratory process. Only by removing these hindrances can we hope to get the benefit of a natural respiration.

Of the value of right physiological breathing in the prevention of disease, it is not necessary to dwell at length before an audience of physicians and advanced students in medicine, but I hope that I may not hurt the feelings of anybody in this amphitheater when I say that in order to impress upon your patient the importance of natural physiological breathing you must practice it yourselves. My main object to-night is to show the value of special breathing exercises in the development of the child, in the prevention of pulmonary diseases, particularly of consumption, and to describe and demonstrate some exercises which seem to me particularly useful in phthisiotherapy and the treatment of some other pulmonary affections.

After having assured yourselves that there is no obstruction in the upper respiratory tract to the free entrance of air, the next most important step is to see that the clothing of the individual to whom you intend to teach breathing exercises, whether he be man, woman or child, does not constrict either throat, thorax or abdomen. The man or woman with a high or tight collar or other neckwear constricting the throat, cannot possibly breathe deeply nor correctly. Not only women but men also at times have the clothing too tight around the chest to permit a free expansion of the thorax. Some men think they can breathe better by wearing belts to hold their trousers. I do not approve of wearing belts for that purpose; it does not facilitate breathing and interferes with the peristaltic action of the intestines, and it may even be the cause of the development of a hernia. While the man perhaps will acknowledge that he is uncomfortably dressed when you so tell him or that the belt, if he wears one, is too tight, a woman will but rarely do so. If she wears a corset she will assure you that it is not at all tightly laced and that there are really no constricting bands around her waist. You must exert all posible tact to convince her of this error, for I believe I do not exaggerate when I say that a large majority of women wearing corsets wear them altogether too tight. Some women must wear a support of some kind, but many of them could get along very well without one, and none need a tightly laced corset, nor need they fasten their skirts in such a way as to constrict the abdomen. If they only would develop their thoracic muscles they would have a natural and more graceful carriage than the one obtained by that little instrument of torture, called the corset. Whenever a support is indispensable let women wear a corset-waist without steel-bones. Skirts should be worn in such a manner that the weight is carried by the shoulders.

A good way to convince your pupil or patient that uncomfortable and restricting garments do not permit free expansion of the chest is as follows: Tell him or her to stand in the morning before dressing and in the evening before retiring, stripped to the waist, in front of the looking glass and there take the breathing exercises which we will describe presently. The pupils or patients will thus realize the difference between breathing with or without restricting garments. They will watch their respiratory muscles developing, and become intensely interested in these lung gymnastics. The exposure of the chest to the air for a few minutes every morning and evening has an additional advantage. The skin which is also a respiratory organ receives a healthful stimulation through this exposure to the cool air. I venture even to say that this air-bath of throat and chest, when regularly practiced, will have a most beneficent influence in the prevention of colds.

Presuming then that you have satisfied yourselves that the pupil to whom you are to teach respiratory exercises is dressed in such a manner that there remains not the slightest restriction around throat, thorax or abdomen, you can begin your instructions. It goes, of course, without saying, that you should teach the breathing exercises always either in the open air or in a well ventilated room, preferably in front of an open window. A locality where the individual, by taking deep breaths, would only inhale an additional amount of impure odors or dust, is, of course, not suitable as a place for teaching breathing exercises. Starting out with the presumption that we find ourselves in suitable environment for respiratory gymnastics we teach our pupil to assume the position of the military "attention"—heels together, body erect, chest forward, head straight, the palms of the hands touching the external portion of the thigh. We tell the pupil to keep his mouth closed and to take a slow deep inspiration through the nose, that is to say, taking in all the air possible with one inspiratory movement, to hold his breath a few seconds, and then exhale just a trifle faster. If the pupil has done this act well, we supplement it by allowing him to raise the arms to a horizontal position. He does this during the act of inspiration, remains in that position for a few seconds

and while exhaling brings the arms down to the original position. The act of expiration should again be a little more rapid than that of inspiration.

When the first exercise (Fig. 1) is thoroughly mastered after a few days, the pupil can be taught a second one, which is like the first except that the upward movement of the arms is continued until the hands meet over the head (Fig. 1). The third respiratory exercise, somewhat more difficult and requiring more strength and endurance, should not be undertaken until the first two have been mastered and practiced for several days. The third exercise might justly be called a dry swim; one takes the same military position of "attention," heels together, body erect, and then stretches out the arms as in the act of swimming, the dorsal surfaces

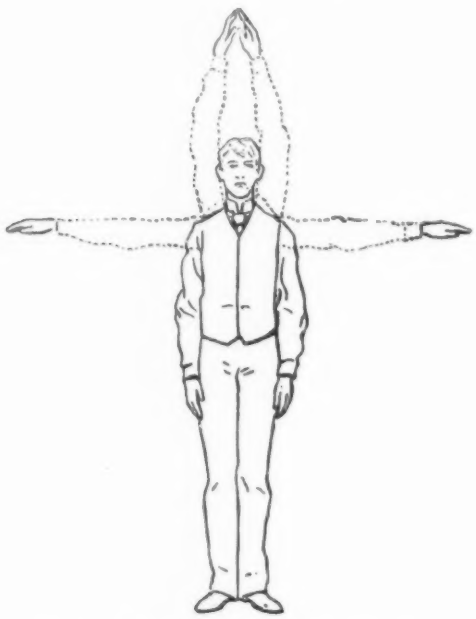

FIG. 1.—First and Second Breathing Exercises.

of the hands touching each other. He then moves the arms, just as if he was dividing the water, during the act of inspiration, the hands meeting finally behind the back. The pupil remains in this position for a few seconds, retains the air, and during exhalation brings the arms forward. This somewhat difficult exercise can be facilitated and made more effective by rising on the toes during the act of inspiration and descending during the act of expiration (Fig. 2.)

Valuable as these exercises with the moving of the arms are, they cannot be practiced everywhere and at all times without attracting attention. Under such conditions one must often content oneself with raising the shoulders, making a rotary movement backward during the act of inhalation, remain in this position, holding the breath for a few seconds and then exhale while moving the shoulders forward and downward, assuming again the normal position. This exercise (Fig. 3) can even be taken while walking and, of course, very easily while sitting or riding in the open air.

Young girls and boys, and especially those who are predisposed to consumption, often acquire a habit of stooping. To overcome this the following exercise is to be recommended. The child makes his best effort to stand straight, places his hands on his hips with the thumbs in front, and then bends slowly backward as far as he can during the act of inhaling. He remains in this position for a few seconds, while holding the breath, and then rises again somewhat more rapidly, during the act of exhalation (Fig. 4).

Concerning the general directions as to the frequency and order of these exercises I can only say here the same that I have said in previous writings when speaking of aerotherapeutics proper: Commence always with the easier exercises and only gradually take the more difficult ones. Repeat the exercises from six to nine times either of one kind or the other, every half hour or so, or three of each, and continue this practice until deep breathing has become a natural habit. One rule which is applicable as well to the pupil whom you teach to breathe to prevent disease as to the patient for whom you prescribe respiratory exercises as a means of cure, is the following: Instruct them never to take the exercises when tired and never to continue them so long as to become tired.

FIG. 2.—Third Breathing Exercise.

Before we proceed to discuss the specific respiratory exercises suitable in diseases, let us also say a few words of the value of speaking, reciting and singing in the open air, or at least in well ventilated rooms or halls. To my mind there is not enough done in the physical education of our

children in this respect. Cases of phthisis which had even passed the incipient stage have been recorded as cured in individuals who, after realizing their condition, decided to follow the occupation of street singer or speaker. I know of the case of an English lady who became an evangelist addressing crowds of people every night in open air meetings and who actually was cured from her tuberculous disease after following this calling for a year. Barth, of Köslin, who has made a careful study of the effects of singing on the action of the lungs and heart, on diseases of the heart, on the pulmonary circulation, on the blood, the vocal apparatus, the upper air passages, the ear, the general health, the development of the chest, on metabolism, and on the activity of the digestive organs, has come to the conclusion that singing is one of the exercises most conducive to health. Considering the fact that it can be practiced anywhere (when the air is pure) or at any time, without apparatus, it should be much more cultivated than it actually is. The German military authorities, who have the reputation of instituting all exercises which tend to invigorate the soldiers, have of late years encouraged singing by the troops during marches.

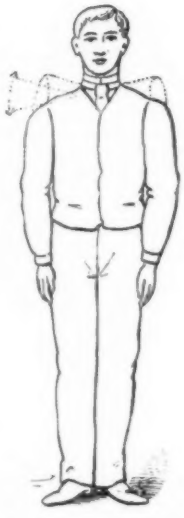

FIG. 3.—Breathing Exercise with Rolling of Shoulders.

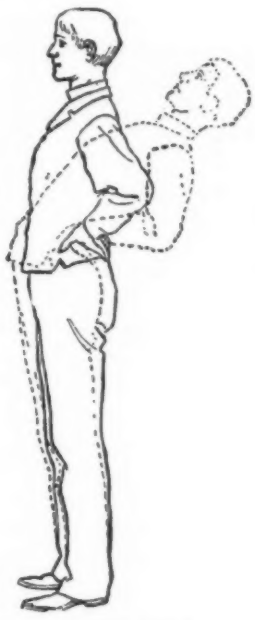

FIG. 4.—Exercise for People in the Habit of Stooping.

We will now speak of respiratory exercises in their therapeutical aspect in various pulmonary diseases. The six pathological conditions of the respiratory system which may be very greatly helped by proper judicious breathing exercises, are bronchitis, asthma, emphysema, an inactive lung owing to a badly resolved or slowly resolving pneumonia, deficient breathing owing to pleuritic adhesion, the remainder of an inflammation of the pleura, or convalescent emphysema, and last but not least, pulmonary tuberculosis.

In ordinary bronchitis, after the acute febrile state has passed, the exercises taught above for the development of a good breathing capacity in children, will answer for all practical purposes. These deep inspirations and expirations will be particularly useful in dissolving the mucus and making the expectoration easier. Except in simple bronchitis or badly resolved pneumonia you will probably find in the affections, just enumerated, if not a deficient development, a more or less pronounced atrophy or inactivity of the abdominal and thoracic muscles which should come into play in deep natural breathing. There is no use in teaching or prescribing respiratory exercises if the muscles which are to perform these exercises are lazy, badly developed or atrophied.

How are we to overcome such an atrophy in an emphysematous, asthmatic or phthisical patient? Electricity and massage are, of course, the best remedies. The most important of the two, and the one which I prefer, is certainly a proper, skillful and regular massage of the abdominal and thoracic muscles. While I do not expect every physician to massage his own cases, it seems to me equally unwise to leave the work entirely to the masseur, masseuse or nurse and content ourselves with telling these, our assistants, simply to massage the patient. We should certainly know ourselves how to do this massage and how to give instruction in this important physical method of curing disease.

Allow me to describe here and to demonstrate before you the method of massaging a patient with badly developed abdominal and thoracic muscles, which has given me the most satisfactory results. I place the patient on a moderately high table or bed with no springs. The height of the bed or table should be suited to the height of the operator. The latter must be able to bend comfortably over the patient and exert a moderate amount of force without getting too tired himself. A low bed with spring can not be used for applying scientific massage.

The room in which the patient is to be massaged should be comfortably warm and always well ventilated. To avoid unnecessary exposure it is well to have a shawl handy so as to protect that portion of the patient which is not manipulated at the time. Whether or not to use vaseline or some other substance for the purpose of lubrication will largely depend upon the masseur or patient. As a rule lubricants are not essential; of course there are cases of tuberculosis, and especially in children, where the use of codliver oil for this purpose may be very advisable.

The four movements which I employ are the following: friction, kneading, tapping and pinching. In the friction movement, and as much as possible in all the others, I like to follow the course of the venous circulation; in abdominal massage I like to bear in mind the situation of the colon, and thus at the same time aid in overcoming a tendency to constipation. This is done by massaging the colon separately, following its course along the ascending, transverse and descending portion. Around the umbilicus a circular motion from right to left is the best to be employed. This

massage of the abdominal wall should be more gentle than that of any other portion of the body and should be supplemented by teaching the patient to retract and relax his diaphragm alternately, holding it for several seconds in the retracted position so as to strengthen all the abdominal muscles. This exercise of diaphragm and abdominal muscles should be taught first to the patient in the recumbent position; later on he should learn to make this movement also in the standing posture. The massage which has the purpose of overcoming an atrophy of the respiratory muscles so that the act of respiration should be more complete, must not in the pulmonary invalid, and particularly in one suffering from chronic tuberculosis, be confined to abdomen and thorax alone, but must include the arms and shoulders as well.

Here is what I believe to be the most convenient method to massage the anterior muscles of forearms, arms, shoulders and thorax. Begin your friction at the tips of the fingers going as far as to the wrist articulation, from there to elbow joints, from elbow to shoulder. By a semi-circular movement, with moderately spread fingers and the palms of the hands, try to take in by your friction movement as much as possible of the posterior and lateral portion of the thorax.

After a few minutes of friction begin your true massage, that is to say, kneading, from the French *masser*, to knead. Manipulate the muscles so as to lift them from the osseous attachment and in the same order as the friction movement. The third movement is the tapping, which may be done with the whole hand, the palmar surface of the four fingers, or if desirable to avoid the clapping sound produced by this movement, tap with the ulnar surface of your hand, producing a sort of chopping movement.

The fourth movement I recommend is pinching, of which the particular purpose is to massage the skin. Pinch rapidly the various portions of the skin which you have already manipulated by friction, kneading and tapping. This pinching is most conveniently done, with least pain to the patient, by lifting a small portion of the skin between the thumb and the index and middle finger.

You now turn the patient on his chest with either the right or left cheek resting on a pillow so that he can breathe easily, while you manipulate the posterior muscles of arms, forearms, etc. in the same order as you did the anterior portion. If you are tall and vigorous and the patient not larger than you, it is possible to apply the friction movement to both arms, both shoulders and right and left portion of the thorax at the same time. This is done by placing the palms of your hands on the posterior portion of the patient's hands and then apply a good friction movement over hands, forearms, arms, shoulders and the posterior portion of the patient's thorax. The kneading, tapping and pinching movements are, of course, the same as for the anterior portion with the only difference that the posterior muscles of the trunk will stand a more vigorous massage than the anterior ones. The time occupied for anterior and posterior thoracic massage should be about thirty to forty minutes.

An exercise which the patient may be taught while in bed and which will add to the good effect of the massage is the following: The patient lies on his back with a small pillow placed under him at about the height of the kidneys, so as to lift up the thorax. He then raises the arms in the air above his head so as to describe a half circle with them. He can, while raising the arms, take a deep inhalation, hold the breath for a moment, and return them to the original position during the act of exhalation, thus adding by active movement to the good effect of the massage. Should your patient be a child your ingenuity will probably be taxed at times in overcoming the thoracic malformation. You will have to resort to some special gymnastics, which, according to the indications, may even have to be aided by a special apparatus for exercising or by orthopedic appliances. The combination of all these means to correct a thoracic malformation is, however, most gratifying in these young children, and I am convinced that if more attention would be paid to the correction of those malformations which prevent the child's lungs from freely expanding, there would be fewer cases of tuberculosis in adult life.

Returning to our adult patient, and presuming that his more or less pronounced atrophy of the respiratory muscles has improved sufficiently under this massage, we will proceed to show what can be done in the various pathological conditions of the lungs through special and judicious respiratory exercise. Emphysema and asthma require a particular kind of respiratory exercise. While, as a general rule in respiratory therapeutics, the act of expiration should always be somewhat shorter than the act of inspiration, in these two diseases we must rather try to prolong the expiratory act. Having by our massage improved the thoracic muscles and the often very flabby condition of the abdominal walls of such an invalid, we tell him to bring all his respiratory muscles into play during the expiratory act. He inhales quietly through the nose as in ordinary inspiration, but we teach him to exhale with his mouth open and place the palms of his hands on his chest, the thumbs directly toward the axillary region, and then exert a strong pressure on his thorax. Through this exercise we endeavor to produce a long continued exhalation. Another valuable aid in recovering the lost tonicity of the pulmonary tissue through respiratory gymnastics is the following exercise which is particularly useful because it can be done without attracting attention, since the pressure with the hands on the thorax, while a valuable help is not always essential nor practical. The patient is told to inhale ordinarily, but during the act of exhaling to place his lips as if about to whistle and then produce a blowing sound as long as he can without taking another breath. We have him repeat this quite a number of times a day, but always according to our formula—never when he is tired and never to the extend of getting tired. The improvement in the condition of many asthmatic and emphysematous patients through such exercises is simply surprising, and while I, of course, would not wish to underestimate any other hygienic, dietetic or medicinal treatment in the various forms of asthma or emphysema, I do claim

that these exercises are most valuable adjuvants in the therapeutic management of such invalids.

We now come to such exercises as I would advise with judicious gradation in number and kind in conditions where either through a badly resolved pneumonia, old pleuritic adhesions, tuberculous deposits, or infiltration there is no longer a proper physiological breathing and sufficient hæmatosis. The exercises I am to describe I have, of course, most frequently employed with my tuberculous patients; but, valuable as they are, I wish to speak first to you of the contra-indications, for respiratory exercises in pulmonary tuberculosis, or any other affection of the lungs, must not be blindly prescribed. A patient in a highly febrile state, or during an acute exacerbation of the tuberculous process, or an active hemorrhage, should refrain from all respiratory exercises. Following a hæmoptysis all respiratory exercises with movements of arms should be prohibited, at least for a time. On the other hand I encourage quiet and deep respiratory movements, a few at the time, following a hæmoptysis. In cases where the sanguine expectoration has continued for weeks these deep, quiet respirations seem to have acted as a veritable styptic. Irritating cough resulting from the attempt to carry out the breathing exercises, or pleuritic pains resulting from the tearing of old adhesions, are no contra-indications to the continuation of the respiratory exercises. Both cough and pain will cease in a short time. As long as the patient has learned to breathe properly through the nose and the air is relatively pure, cold, warmth, rain, snow and even wind should not prevent the patient from carrying out the physician's instructions for breathing exercises.

At times there are cases in which you desire to direct your respiratory exercises, so as to develop more particularly either the right or left lung. Under such conditions I have been in the habit of temporarily strapping the healthy side of the chest with the aid of adhesive plaster. Since coming to Baltimore my attention has been called to a much simpler and equally efficacious method, namely that of Naunym. I take the liberty to demonstrate this exercise before you, and take particular pleasure in doing so, for I am indebted for this acquisition of knowledge to your distinguished teacher, Professor Osler. He showed me that by sitting in an ordinary chair, with the healthy side of the chest pressing against the back of this chair, one could almost immobilize temporarily the healthy side, and by a deep respiration inflate the opposite lung to a much greater extent than would be possible without this fixation. Prof. Osler told me of what good service this method had been in patients convalescent from an empyema. I have been experimenting since in my room at the hotel and have learned that all chairs are not suitable for this excellent exercise. A chair with a concave back is utterly useless for that purpose. Naunym's breathing exercises for developing the right or left lung separately can best be carried out with an ordinary chair, with a seat low enough for the patient to fix his feet solidly on the floor. The back should be straight or moderately convex, and low enough to enable the patient to fix the top of it in his axilla, putting his arm over the back and taking a firm hold of the seat from the outside. All the other directions for proper breathing, such as closed mouth, head erect, unrestricting clothing, are of course as important for this exercise as for any other. A second expiratory effort which we will describe presently may also be added to enhance the good effects of Naunym's exercises.

In all chronic forms of tuberculosis I have found the above described ordinary respiratory exercises of the greatest value. To increase their efficiency I have added a few movements to my armamentarium. While we need not be over-careful and over-precise when teaching respiratory exercises to a relatively healthy child, or young man or woman, in order to develop the chest capacity and respiratory function in the tuberculous patient we cannot be too careful in this matter. Not only the consumptive's physical but also his psychic condition demands that our prescriptions for respiratory exercises should be considered as important as the administration of any medicinal substance. In the modern teachings of phthisiotherapy air, air, and air again holds the first place, and to utilize as much as possible of this valuable substance we must not only have our consumptive patients live outdoors all day, resting either on a reclining chair or exercising by judiciously gradated walks, and at night have him sleep with the window wide open, but we must also see that he gets as much as possible of the good, fresh air into his lungs. I therefore add to the ordinary exercises an additional movement by having each respiratory act, that is to say, after a deep inspiration and corresponding expiration, followed by a second forced expiratory effort. This is for the purpose of expelling as much of the supplemental air as possible, which may be effectually aided by supinating the arms and pressing the thorax with them.

Considering that the amount of tidal air—that is to say, the volume which is inspired and expired in quiet respiration—is only 500 cc., the complemental air—the volume which can be inspired after an ordinary respiration—1500 cc., and the supplemental or reserve air—the amount which can be forcibly expelled after an ordinary respiration—amounts to 1240 to 1800 cc., one can readily see the value not only of deep breathing, but particularly of this second expiratory effort.

I may, perhaps, be permitted here incidentally to make a few remarks on the deficient respiratory function of the apices. The fact that in the majority of cases the tuberculous process begins at the apices has been explained by the supposed bad inspiratory function of this part of the lungs. Now, I agree in this respect with Hanau,[1] and consider the almost universally adopted statement of the deficient inspiratory function of the apices erroneous. On the contrary, these portions of the lungs inspire excellently well, almost too well, for dust and all sorts of micro-organisms enter there most easily and are found in large quantities in careful post-

[1] Hanau, A., Zürich, "Beiträge zur Pathologie der Lungenkrankheiten." (Zeitschr. f. klin. Medicin, xii, 1887).

mortem examinations. What is faulty is the expiratory function of the apices. A thorough expiration followed by a forced expiratory effort, as just described, is, to my mind, the only possible way to improve this defect and prevent stagnation and congestion, which, as is well known, form excellent media for the development of bacilli.

I will lastly demonstrate before you systematically the four or six exercises which I prescribe to my tuberculous patients according to their condition. To exercise No. 1, which for pedagogic purposes consists simply in raising the arms to the horizontal during the act of inspiration and to lower the arms during the act of expiration, I add the following: I instruct the patient, while his arms are stretched out in the horizontal position, to count three silently and slowly by moving the hands up and down, and then lower the arms during the act of expiration. Following this without inhaling again, he makes a second expiratory effort, as described. This second expiratory effort is not easy to teach and some patients are not able to learn it at all. Why, I cannot tell, but I usually succeed, at least in a measure, by having the patient say the word "inch," prolonging the vowel during the attempted second expiratory effort. To the second ordinary exercise, where the patient raises his arms above his head, I add a bending backwards of head and thorax while the patient retains the air. This bending backward and coming back to the original position requires about five seconds; and the exercise is again followed by the second expiratory effort. This exercise will also tend to overcome the habit of stooping. The third or swimming exercise, which you can only use for the tuberculous patient nearing recovery, may also be made more efficacious by a good vigorous second expiratory effort. The fourth respiratory exercise with rolling the shoulders which, as has been said, can be taken without attracting attention on the reclining chair, while walking or riding, should also be followed, whenever possible, by a second expiratory effort. This is an equally good exercise for patients in bed.

In teaching these breathing exercises I have not attempted to classify abdominal and thoracic breathing. For individuals predisposed to tuberculosis, consumptives and other bad breathers, abdominal and thoracic breathing should be combined to assure the greatest possible play and expansion of the lungs.

The value of respiratory exercises is now conceded by all phthisio-therapeutists. To assure a good, complete hæmatosis, that is to say, as nearly as possible a perfect oxygenation of the blood, to relieve the congested lungs of mucus and facilitate expectoration, diminish inflammatory exudates, in short, improve the respiratory and circulatory processes in the tuberculous patients, or those suffering from similar diseases, I know of no better means than judicious and regular breathing exercises under the supervision of a well trained physician.

16 West Ninety-fifth Street.

PULMONARY TUBERCULOSIS IN BALTIMORE.[1]

By H. Warren Buckler, M. D.

A study of the mortality records of any of our large cities shows Pulmonary Tuberculosis or Consumption to be the most prevalent as well as the most fatal disease existing to-day. It causes about one death to every ten, and its victims average between the ages of 15 and 60, the best periods of one's life. With the exception of pneumonia and cholera infantum phthisis causes more deaths per annum than any other three diseases with which man is afflicted. During the past twenty-five years, from 1875 to 1900, there have been in Baltimore more than 28,479 deaths from phthisis, to say nothing of the deaths due to other forms of tuberculosis. The total mortality for the same period has been 222,562, making a ratio of 12.8%. During the past five years the death rate has been a trifle lower, owing no doubt to the greater ease with which we are able to recognize the disease, and to arrest its progress in its incipient stage. By years the rate is as follows:

Year.	Phthisis.	Total Mortality.	Percentage.
1895	1.141	10,301	11. %
1896	1.222	9,919	11.3
1897	1.047	9,329	11.2
1898	1.061	10,385	10.2
1899	.974	10,152	9.6

[1] Read before The Laennec, a Society for the Study of Tuberculosis, January 30, 1901.

Of the 10,700 persons who died last year in this city, 1050 were victims of pulmonary tuberculosis, whereas scarlet fever, diphtheria and typhoid fever, three diseases usually dreaded, were together accountable for only 490 deaths. A comparison of the death rate of Baltimore with those of a few of our principal cities is not at all unfavorable, especially when one considers our large negro population, among whom the disease is especially fatal. The following chart, made from the tables of vital statistics of the several cities, shows the number of deaths, resulting from phthisis during the past year with its relative percentage to the total mortality.

Name of City.	Total Mortality.	Phthisis.	Percentage.
Baltimore	10,700	10.56	9.8%
New York.....	70,872	8.155	11.5
Philadelphia	25,078	2.717	10.8
Chicago	21,809	2.514	11.3
Boston	11,154	1.289	11.5
Dist. of Columbia.	6,026	.758	12.5

The above will show that Baltimore, even with its 80,000 or more negroes, is not the hotbed of tuberculosis as many would believe, and when we consider that for the past few years every effort has been made in many of these cities to reduce the mortality from phthisis, whereas in Baltimore practically nothing has been done, the comparison is still

more comforting. In order to have a more definite idea of the disease as it exists to-day in the city, I have endeavored to study the conditions in the different wards and districts with the hopes of getting an idea of the relative prevalence of the disease in the several sections of the city. This I have found to be extremely difficult as there are at present no means of ascertaining either the number or the location of cases. It has been estimated that there are to-day about 10,000 consumptives in the city, and until some method of notification of registration is adopted, it will be impossible to study the distribution of the disease except through acquaintance of small areas personally visited or from a study of the annual death list.

Through the courtesy of Dr. C. Hampson Jones, our assistant health commissioner, I have been privileged to show you this evening a map prepared by him, showing the exact location of every death from pulmonary tuberculosis from January 1, 1900 to January 1, 1901, copied directly from death certificates on file in the office of the health department. On this map the white pins represent the deaths among the whites, and the black pins give us an idea of the ravages of the disease among the negroes. The city, as you see, is divided into twenty-four wards, varying in population from 16,500 to 35,000, and containing from 2500 to 9000 dwellings. The ninth, eleventh, twelfth, sixteenth, seventeenth, eighteenth and nineteenth are largely suburban, although comparatively thickly settled in some portions. In these wards where fresh air and sunshine are plentiful, the death rate from tuberculosis is low, averaging during the past year only about six per cent. The only region to which I wish to call your attention in these outskirts of the city is Hampden, a small village settlement between Jones' Falls and Woodberry, and populated largely by mill hands. In this neighborhood there occurred last year seventeen deaths from pulmonary tuberculosis, and I personally at present know of four cases from this suburb undergoing treatment at the Johns Hopkins Dispensary. Notice how few cases occur in the neighborhood of Clifton, Druid Hill Park, Walbrook and Irvington, all localities fully as thickly populated. It is interesting to know how few deaths have occurred in the extreme southern sections of the city and around Locust Point. These are all regions thickly settled, occupied by laboring people, in some houses very much crowded, and living under the most unhygienic surroundings. Yet you see that only three deaths resulted from phthisis during the past year in this part of the city. This I believe, is due to the existence of the large gas works which impregnate the air with fumes from their furnaces, thus rendering it, to a certain extent germicidal. I have been informed by practitioners of this neighborhood that consumption is of extremely rare occurrence in this part of the city, and this explanation seems interesting as well as satisfactory.

The part of the first ward bounding the basin and containing the shipping and dirtiest business section of the city, and the second ward, in which are located the great majority of shops, warehouses and public buildings, have a comparatively low death rate from phthisis, owing to the small population and few dwellings.

One could not have better proof that tuberculosis is essentially a filth disease, flourishing in unhygienic surroundings, than to know how practically exempt from the disease the better residential sections of the city are. For example in the 13th ward, in an area bounded by Franklin Street on the south, North Avenue on the north, Park Avenue on the east and Jones' Falls on the west, there have been no deaths during the past year from tuberculosis. Again in the 15th ward, in the neighborhood surrounding Eutaw Place, between Druid Hill and Park Avenues, there have been no cases of phthisis reported to the health authorities. But to the west of Druid Hill Avenue, where our melanotic citizens predominate, the death rate from consumption is little short of appalling. In the 14th ward, with an estimated population of 23,000, there are 12,000 or more negroes. The death rate from tuberculosis in this ward for the past year was a trifle over 18%. There is scarcely a block in this ward in which there has not been reported a consumptive death during the past year. Quite recently I have been making a house to house visitation in some of the neighborhoods especially infected, and the results promise to be most interesting. In one house especially I have found that during the past two years there have been three deaths from tuberculosis in one family, which had previous to the occupation of this house been perfectly healthy. Upon questioning the neighbors, I learned that the previous occupant had died of lung trouble shortly before the present family moved in. A small triangular section, bounded by Richmond, Cathedral and Biddle Streets, is an area of considerable interest, as it is a part of the city familiar to most of us, and also because it serves as an especial menace to those portions of the city previously mentioned as being free from the disease. In this small area there were ten deaths during the past year from phthisis, seven blacks and three whites. I would like to call your attention to the 10th ward, one of the smallest of the city, bounded by Jones' Falls, Preston, Caroline and Monument Streets. This little ward has a greater population per acre than any other ward, with a total death rate of about 500, and a percentage from phthisis, of about 15%. The adjacent ward, the 8th, in which this hospital is located, one of the largest wards of the city, has the greatest number of actual deaths per annum from tuberculosis, averaging between 90 and 100. But a correspondingly large total mortality brings the ratio down 10%. This ward has about the same population as the 10th, but scattered over an area of nearly twice the size, and occupying four times as many dwellings. Does it not therefore seem probable from the above that overcrowding, poor ventilation and lack of fresh air and sunshine are not the sole causative factors in the spread of the disease, but that certain districts seem to be more especially tainted with tuberculous infection than others, and that to a certain extent, where one lives seems to be as important as how one lives. The degree of elevation has seemed to have little effect upon the distribution of the disease. The difference

between sea level and the highest point in the city is only that of a few hundred feet, and as I have already shown some of the worst infected districts are in sections of the city comparatively high, whereas in the neighborhood of the water front and Locust Point the disease is of unusually rare occurrence.

What may be the best practical methods of reducing the dangers from tuberculosis are problems of such enormity as to be entirely beyond the scope of a paper of this length, suffice it to say that it is only a question of time before our municipal authorities will be forced to adopt stringent regulations, such as have proven successful elsewhere in checking the spread of the disease. Maryland, unlike many of our States, has as yet done nothing, but the legislatures of New York and Pennsylvania have already passed laws requiring registration of all cases of tuberculosis at the offices of the health department, thus placing consumption upon the list of notifiable diseases. Dr. Herman Biggs, of the New York health department, at present estimates that he is enabled to have under surveillance 9/10 of all phthisical subjects. By forcing some and by teaching others to properly dispose of their expectorations, and by disinfecting the quarters of the patient after death, he believes that he has in the past six years reduced the mortality nearly 35%, which means the saving of 1500 lives annually. If to this society can be given the credit of stirring up in Baltimore such interest as may be necessary to insure the adoption of similar preventive measures, surely the idea which originated its foundation will have been a happy one.

N. B.—The numbers and boundaries of the city wards referred to in this paper are those which were in existence at the time of its first presentation.

CONCERNING A DEFINITE REGULATORY MECHANISM OF THE VASO-MOTOR CENTRE WHICH CONTROLS BLOOD PRESSURE DURING CEREBRAL COMPRESSION.[1]

By Harvey Cushing, M. D.

During the course of a long series of observations undertaken for Professor Kocher in the Physiological Institute of Bern in an attempt to elucidate certain questions of dispute regarding the circulatory phenomena which are consequent upon cerebral compression, it has been observed that there is a constant tendency on the part of the blood pressure to remain at a level above that of the pressure exerted upon the brain.

The fact that cerebral compression occasions a rise in blood pressure is universally known but it does not seem to have been recognized that the degree of this elevation occurs *pari passu* with the degree of compression (measured in millimetres of mercury) to which the medullary centres are subjected. It is ordinarily stated by the numerous experimentors who have dealt with problems of compression that fatal symptoms originate when the intracranial pressure approaches or reaches the height of the arterial tension. The fact that the arterial tension is a varying quantity which regulates itself so as to overcome the effects of the increased intracranial pressure seems never to have received attention.

In the greater number of my early observations the experimental compression has been made by means of quicksilver which was allowed to enter a thin rubber bag at the end of a metallic canula which was screwed into a trephine opening in the skull. By this method it was impossible to estimate with exactitude the degree of compression exerted against the medulla since the elasticity of the bag, the resistance of the dura in spite of its preliminary liberation from the skull, and the fact that the brain does not transmit the pressure from such a localized foreign body equally in all directions were always elements of uncertainty in the calculation. Nevertheless the method sufficed to call attention to the fact above mentioned, namely, that when the degree of compression was increased so as to exceed that of the blood pressure the latter would in turn almost invariably rise to a level exceeding that of the intracranial tension. In this way the blood pressure could be carried to indefinite heights, occasionally to 250 mm. of mercury or more, and be held there until the centres in the medulla became permanently fatigued.

The suggestion thus offered as to a definite regulatory mechanism which counteracts the compression anæmia by elevation of blood pressure was further strengthened by direct observation, of the cerebral circulation through an accurately fitting glass window inserted in another trephine opening under which the dura had been opened. When the intracranial tension had been carried up to the point of blanching the convolutions and indeed of obliteration of the pial arteries themselves, it could be seen through this fenestra that this condition of anæmia was but a transient one, since in a few seconds the vessels would once more fill and the circulation become reestablished. On some occasions, to be explained later, the circulation could be seen to appear and disappear with rhythmic periodicity, the intracranial tension meanwhile remaining at the same level.

The opportunity of testing the truth of the hypothesis thus suggested has been offered in the *Laboratorio di Fisiologia* of Turin[2] where a simple but more graphic method of

[1] Reprinted from the Archives Italiennes de Biologie for 1901.

[2] I am deeply indebted to Professor Mosso in Turin and to Professor Kronecker in Bern for extending to me the privileges of their laboratories while carrying out these observations.

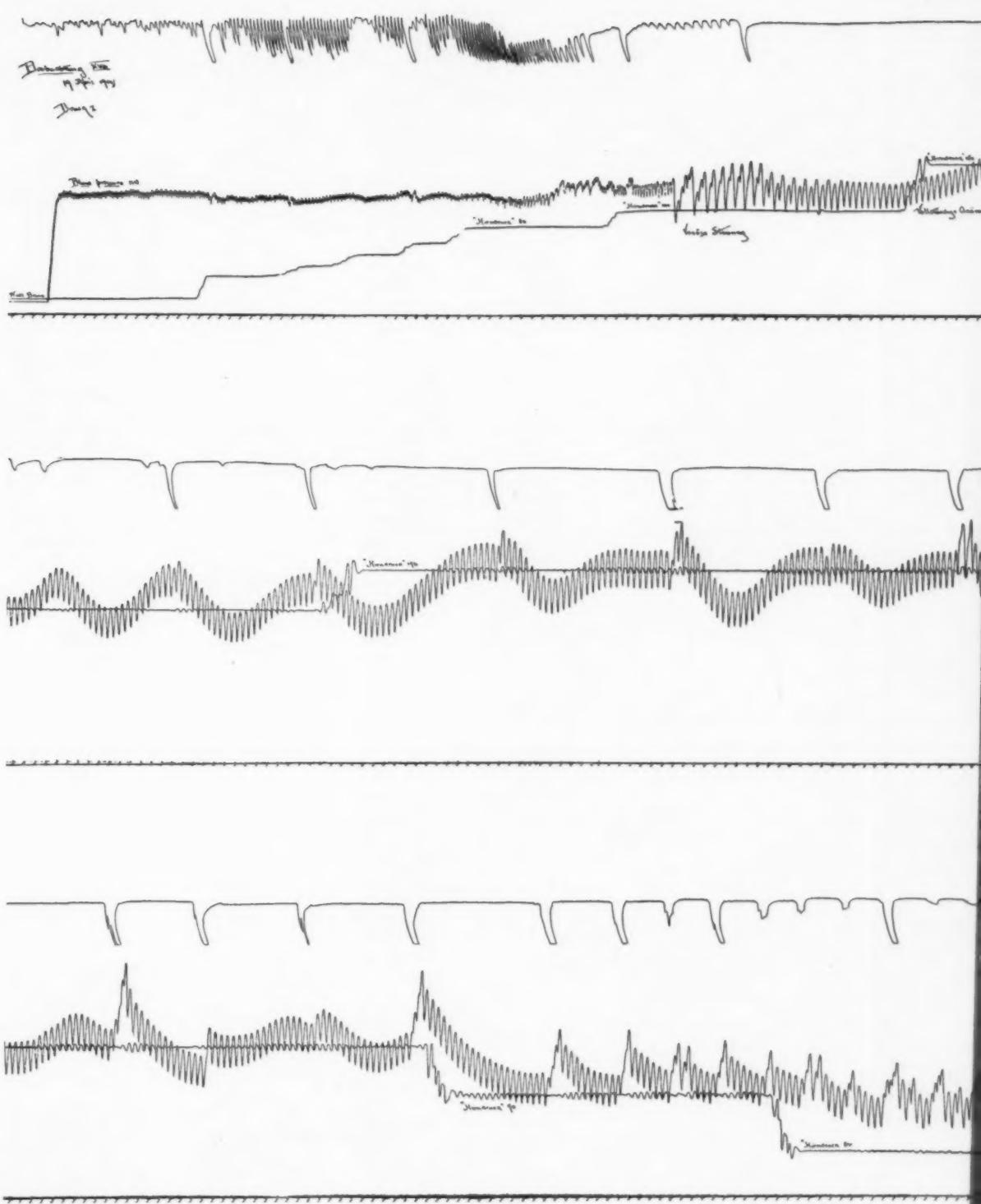

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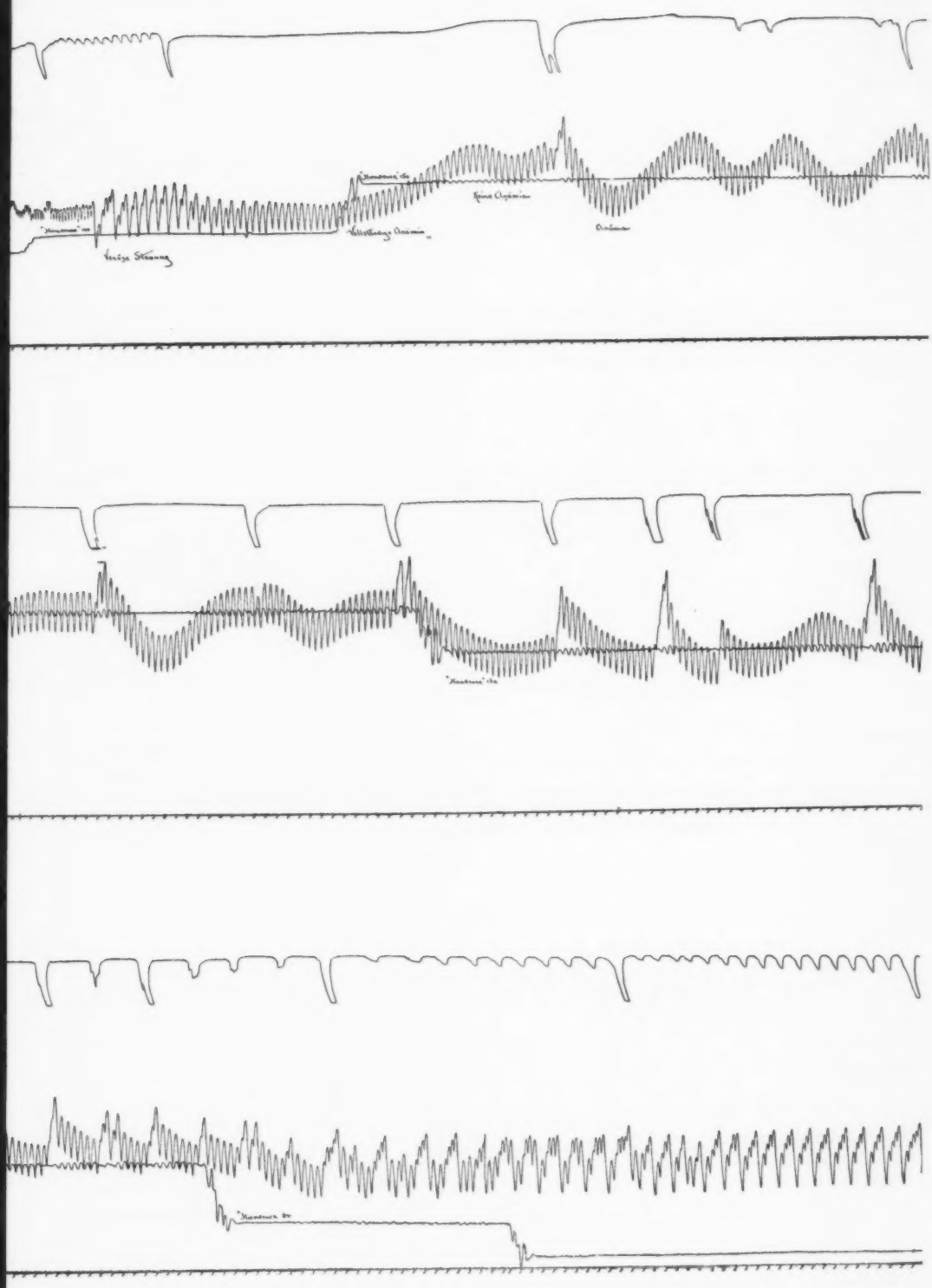
CHART I.—Animal in normal condition. Intracranial tension increased to 196 mm. of Hg, carrying with it the blood pressure



196 mm. of Hg, carrying with it the blood pressure from its normal level at 114 and producing vaso-motor curves.

demonstrating this coincidence of blood pressure and degree of intracranial tension has been employed. In this Turin series of observations the animals employed have been invariably dogs. In Bern the same phenomena have been observed in other animals.

Method of Experimentation.—A preliminary injection of morphia has been given and the animals have been lightly anæsthetized with ether.

Blood pressure has been recorded from the femoral artery lest the ligation of one of the carotids should in any way disturb the intracranial circulation.

For direct observation of the circulatory condition of the brain a large trephine opening has been made in the median line in such a situation as to avoid the large emissary veins which pass between dura and diploæ not only from the great lateral cerebral veins anteriorly but posteriorly from the torcular itself. The dura is opened to one side of the longitudinal sinus exposing part of a convolution, its limiting sulci and the pial vessels. In the trephine opening an accurately fitting glass window is inserted through which the degree of distension or compression of the longitudinal sinus (unless the animal be very old), the condition of the capillary circulation in the exposed convolution and the vascularity of the pial vessels can be beautifully seen during the subsequent experiment.

The intracranial pressure has been produced and recorded as follows. Another, much smaller trephine opening is made over one part or another of the cerebrum, cerebellum or cord (in the latter case by trephining the lamina of one of the vertebræ). The underlying dura is carefully and freely opened. In the trephine hole an accurately fitting metal canula is screwed to which a firm rubber tube is attached communicating with a flask of physiological salt solution so arranged that it may be raised or lowered for the production of pressure to any desired level (cf. sketch). The rubber tube leads through a basin of hot water so that the fluid entering the cerebro-spinal space may be approximately at body temperature. The tube furthermore communicates with a mercury manometer which thus registers the degree of intracranial tension. In this way the cranial cavity is converted into a plethysmograph and the volume-pulse as well as the tension of the liquor can be graphically represented.

The blood pressure and intracranial tension may thus be recorded side by side on a kymographion, the manometers being so arranged that the zero pressures are taken from the same abscissa, (of sketch).

Respiration and time, the latter with a two second interval, are also recorded on the charts.

By the devices ordinarily made use of for the production of cerebral compression, especially by the introduction over the hemispheres of circumscribed bodies, solid or otherwise, no exact indication of the degree of pressure over the medulla is given since it is well known that pressure so applied is not transmitted equally throughout the three large cerebral chambers which are limited by tentorium and falx. In some animals indeed the brain may be so dislocated that the medulla may to a large extent be crowded through the foramen magnum and the vaso-motor centre thus partially escape from the compression effects to which the cerebrum is subjected. For this reason it was essential for our purposes to employ a method in which the intracranial tension over the fourth ventricle was to all intents and purposes equal to that which we were measuring in millimetres of mercury at the point of application of pressure. In no other way could an accurate comparison with the blood pressure be made.

It might be supposed and has heretofore been stated that the extraordinarily free communication between the cerebro-spinal space and the cranial venous circulation would lead to a rapid overfilling of the right heart, should a continuous supply of artificial liquor under an abnormal pressure be afforded. As a matter of fact during life and when the blood pressure remains above that of the intracranial tension this escape of liquor is not exceedingly rapid. During a long experiment with the intracranial tension of this fluid varying from one to two hundred millimeteres of mercury and so held from ten to twenty minutes at a time, on an average only 80 to 100 cc. of the salt solution would be taken up by the circulation, certainly not enough to alter the reliability of the observations. On the other hand, after the death of the animal with a zero blood pressure the liquor enters the veins and thus the heart with much greater rapidity.

Care must be taken that the dura corresponding to the trephine opening for the canula be accurately excised and that the compression fluid be not allowed to enter from a high pressure with too great abruptness since under such conditions the dura may be flattened against the brain and the fluid collect as a foreign body between the membranes and skull instead of passing freely in all directions over the entire central nervous system. Under these latter circumstances and provided that the pressure from without is kept at a constant level the tension of the fluid in the cerebro-spinal space is the same throughout and the absorption which is in too small amounts to embarrass the cardiac action, may be disregarded. Thus, very slight, if any, differences can be observed in the regulatory mechanism to be described, whether the fluid be allowed to enter primarily, over cerebrum, cerebellum or cord.

The accompanying charts demonstrate more plainly than can any description the striking regulatory phenomena on the part of the blood pressure, as controlled by the vaso-motor centre, which occurs during varying degrees of medullary compression.

Until the intracranial tension (“*Hirndruck*”) exceeds that of the blood pressure, nothing more than the usual slight excitatory phenomena (cf. Chart I) are seen, indeed if the fluid enters easily without compromising the sensitive dura this primary quickening of pulse and respiration may be absent (cf. Chart III.)

When, however, the pressure is increased until it exceeds that of the blood pressure and especially if this high intracranial tension has been rapidly produced (as in Chart III) we may occasion momentarily the so-called major symptoms of compression with Kussmaul-Tenner spasms, evacuation of bladder and rectum, practical cessation of respiration and pronounced vagus effect upon the heart often with a complete "*Stillstand*" lasting from ten to twenty seconds. Then follows a release from this extreme vagus inhibition and the vasomotor centre begins to exert its striking influence.

In the more simple condition when the pressure has been increased more slowly (Chart I), these vagus symptoms are often avoided and the rise in blood pressure follows immediately upon the increase of "*Hirndruck*" to a level which temporarily exceeds it. Under these circumstances and when there has been no pronounced vagus effect (as in Chart III, where the sudden release from vagus inhibition has temporarily let the vaso-motor action run away with the blood pressure) it can be seen that the rise in blood pressure is merely sufficient to carry it above the level of the compression fluid, in other words an arterial pressure is called out which suffices once more to carry blood to the centres in the medulla. If, as in Chart III, an unnecessary elevation of blood pressure has primarily been occasioned it will fall and continue along a line representing a level slightly above that of the compression. Should the intracranial tension be again increased the same phenomena will be again repeated (cf. Chart I), and in this way the blood pressure may be forced to a level considerably over 200 mm. of mercury before the vaso-motor centre shows signs of giving way and fails to respond to the demands of an anæmic medulla. Within reasonable limits of compression, however, this compensatory action may be indefinitely prolonged.

On many occasions, as in Chart I, the blood pressure may be seen to rise and fall, above and below the line representing the degree compression, with a rhythmic periodicity of one form or another (Traube-Hering waves, etc.). This phenomenon is readily explained by observation through the glass window of the circulatory condition of the brain, a state of absolute anæmia accompanying those periods when the blood pressure is below the level of the compression line, an abundant circulation being present when it is above. As the average line of blood pressure is raised to a higher level by increasing again the degree of intracranial tension it carries with it this same rhythmic activity (cf. Chart I).

It is the object of this communication merely to state the existence of the regulatory function above described, and the writer makes no pretense at theorizing over the physiological laws which govern it. However, the following observations demonstrate that the process depends largely for its action upon the vaso-motor centre and the control which the latter exerts over the great splanchnic circulation.

1. If the vagi be divided and compression subsequently be made upon the brain, the blood pressure will be seen to correspond even more closely than before to the degree of intracranial tension (cf. Chart II) always remaining slightly higher than the pressure exerted against the medulla or else passing above and below it with wave-like rhythm. The vagus effect (as shown in Chart III) of course is absent under these circumstances.

2. If a coil of small intestine be exposed, during such a compression experiment as has been described, the splanchnic vessels can be seen to contract during the rise in blood pressure and to dilate once more as the latter falls at the end of the experiment.

3. Again if through a trephine opening in the atlas the spinal cord be divided with a blunt instrument so as to occasion the slightest possible bleeding, and then pressure be applied, the vagus effect alone will be forthcoming with no rise in blood pressure (cf. Chart IV), at least until the independent spinal centres shall have asserted their individual activity, when a slight rise may be occasioned.

4. If both vagi and cord be thus divided an increase in intracranial tension does not affect in the slightest degree the level of blood pressure (cf. Chart V.)

5. Similarly cocainization of the medulla by the introduction of the needle through the occipito-atlantal ligament, throws out the action of the bulbar centres. Under these circumstances, if artificial respiration be instituted the animal may live with a temporarily paralysed vaso-motor centre and an increase of intracranial tension does not affect the blood pressure until the cocaine effect begins to wear away.

As a result of these experiments a simple and definite law may be established, namely, that *an increase of intracranial tension occasions a rise of blood pressure which tends to find a level slightly above that of the pressure exerted against the medulla.* It is thus seen that there exists a regulatory mechanism on the part of the vaso-motor centre which, with great accuracy, enables the blood pressure to remain at a point just sufficient to prevent the persistence of an anæmic condition of the bulb, demonstrating that the rise is a conservative act and not one such as is consequent upon a mere reflex sensory irritation.

THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains details of hospital and dispensary practice, abstracts of papers read, and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

Volume XII is in progress. The subscription price is $1.00 per year. The set of twelve volumes will be sold for $23.00.

PENDULOUS TUBERCLES IN THE PERITONEUM.

BY W. G. MACCALLUM, M. D.

As has long been known, there are formed in the Perlsucht or peritoneal and pleural tuberculosis of cattle masses of various sizes, of caseous or calcified material surrounded by a fibrous capsule and embedded in a loose proliferated connective tissue arising from the subperitoneal tissue. These masses often reach very considerable dimensions, and from their weight become pendulous, drawing out the underlying tissue into a stalk—often there are adhesions and such band-like adhesions bearing several caseous nodules have somewhat the appearance of a string of pearls, whence the name. Virchow's[1] illustration and description of this condition are very accurate, although he considered it a form of lymphosarcoma.

In human beings, however, such a form of tuberculous peritonitis is not so common, and I have been able to find in the literature the description of only one such case; Bizzozero,[2] who describes this case was unable to find records of a similar case, and in the admirable reviews of the recent literature by v. Brunn,[3] there is no mention of such a condition.

Bizzozero's case was that of a young peasant 24 years old, who died with the diagnosis of pulmonary tuberculosis. At the autopsy the lungs were found to contain masses of conglomerated tubercles, and there were already cavities at the apices. In the peritoneal cavity was a litre of seropurulent fluid and the intestinal loops were firmly adherent to one another and to the liver by means of a yellowish exudate, which was also found between the liver and the diaphragm. On removal of this exudate covering the intestines, it was found that the peritoneum, both visceral and mesenteric, was covered with most numerous whitish tuberculous nodules of the size of the finest grain of millet to that of a pea. Sometimes they united to form a plate of the size of a five lira piece. Numerous tubercles were found in the parietal peritoneum and subserous connective tissue also. The mesenteric glands were enlarged—microscopical examination shows in them the usual tuberculous detritus.

The mucosa of the stomach was normal, but in the ileum it was pigmented, and numerous tuberculous ulcers corresponding with which there were especially numerous tubercles on the peritoneum.

More careful examination of the peritoneal tubercles—especially those of the mesentery, demonstrated that their nature was varied enough. Some were embedded in the tumefied peritoneum and showed only as spots of rather white color—others produced a sensible elevation—others projected by their whole height above the level of the peritoneum—finally others were not attached at their point of origin except by a peduncle of a length varying from a millimetre to a centimetre, and varying in diameter from 1 to $\frac{1}{3}$ or $\frac{1}{4}$ of a millimetre—often the peduncle was flattened together, so that with a width of $\frac{1}{2}$ centimetre it might have a thickness of only $\frac{1}{3}$ to 1/10 millimetre. The histological constitution of the tubercles immersed in the peritoneum and those with peduncles was the same, and as usual had outside a layer of connective tissue in active proliferation and internally the elements in detritus and fatty degeneration.

"The microscopical examination of the peritoneum," he says, "shows me the probable reason why, while in other cases of tuberculosis the small neoplasms are adherent to the peritoneum, in mine they were for the most part pedunculated. The preparations show that the connective tissues of the membranes were separated by an abundant hyaline fundamental substance in which were numerous new-formed cells, of which some were spherical or oval, others fusiform or stellate—naturally the peritoneum, tumefied and softened by the presence of superfluous fundamental substance and of numerous new-formed cells could not support the weight of the tubercles, and yielding, formed of necessity a peduncle.

"The layers of muscular fibres have taken no part in the new formation. Only in the interfascicular connective tissue was there proliferation of cells.

"This case leads me to believe that, in all probability, tubercles might also produce a kind of free body in the peritoneum, as is the case with fibromata, lipomata, etc., and even sclerosed appendices epiploicae (Virchow, Krankh. Geschw., i, p. 384).

The case which occurred in this hospital was that of a white woman, aged 38, who died with symptoms of pulmonary tuberculosis.

At the autopsy, the peritoneal cavity was found to contain no excess of fluid, and the peritoneal surfaces were smooth and glistening. There were, however, nodules lying just under the serous surface, scattered over both parietal and visceral layers. These had a most extraordinary arrangement—they varied in size from 1 or 2 mm. to 2 cm. in diameter. Some were sessile and flattened and projected only a few mm. from the general peritoneal level, but most of the nodules hung free, each in a sort of long blind tube

[1] Virchow, Krankh. Geschwülste, ii.

[2] Bizzozero, Morgagni, vol. lx, 1867.

[3] von Brunn, Centralbl. f. Allg. Path. u. Path. Anat., Bd. xii, No. 1 and 2, 1901.

formed apparently by the drawing out of the peritoneum into a tubular pedicle. Some of these pedicles reached a length of 10 to 12 cm., although most of them were much shorter and broader. The long ones generally took their origin from a wide uplifting of the peritoneum, and in some part of their length they were often narrowed to a width of only 1 to 2 mm., when they became much twisted and tangled with one another. All of these pedicles contained fluid which if the terminal caseous nodule were allowed to hang down, ran downward to the end of the tube, distending it to a globular ball; by elevating the end, the somewhat reddish fluid could be made to run back and spread out under the peritoneum over the intestine and perhaps even to enter another tubular pedicle. In one or two cases such tubular prolongations show no caseous mass at the end, and indeed one elongated sac with extremely thin, delicate walls and clear, yellow fluid contents was found entirely free in the peritoneal cavity. This body tapered to a point at each end and, as described above, the fluid could be allowed to run to either end, forming a globular bubble-like distended mass, the remainder collapsing into a delicate string. In some cases large sessile caseous masses were found to be overlaid by a loose peritoneal film which formed part of the wall of the large pedicle of some other mass, and in others this uplifting of the peritoneum from the surface of the sessile nodules was incomplete, so that the peritoneal film appears to start from the middle line of the nodule—finally in some cases, small caseous nodules were found hanging by a stalk inside the elevated peritoneum.

The peritoneum thus drawn up was furnished with numerous widely dilated vessels—in some of the pedicles, however, undue twisting had produced strangulation, and the tissue had a dark purple color. Such pedicled nodules which were opaque and yellow, and on section showed large areas of caseation, arose from and were attached to any part of the peritoneum, parietal as well as visceral, and even from that covering the pelvic organs. The intestinal mucosa appeared normal except for two small ulcers in the cœcum opposite the attachment of one of the large subserous masses. The lymph glands in the abdomen were apparently not involved—lymph glands lying side by side with the caseous nodules showed, even when examined microscopically, no alteration. The cervical and mediastinal lymph glands, however, were almost entirely caseous.

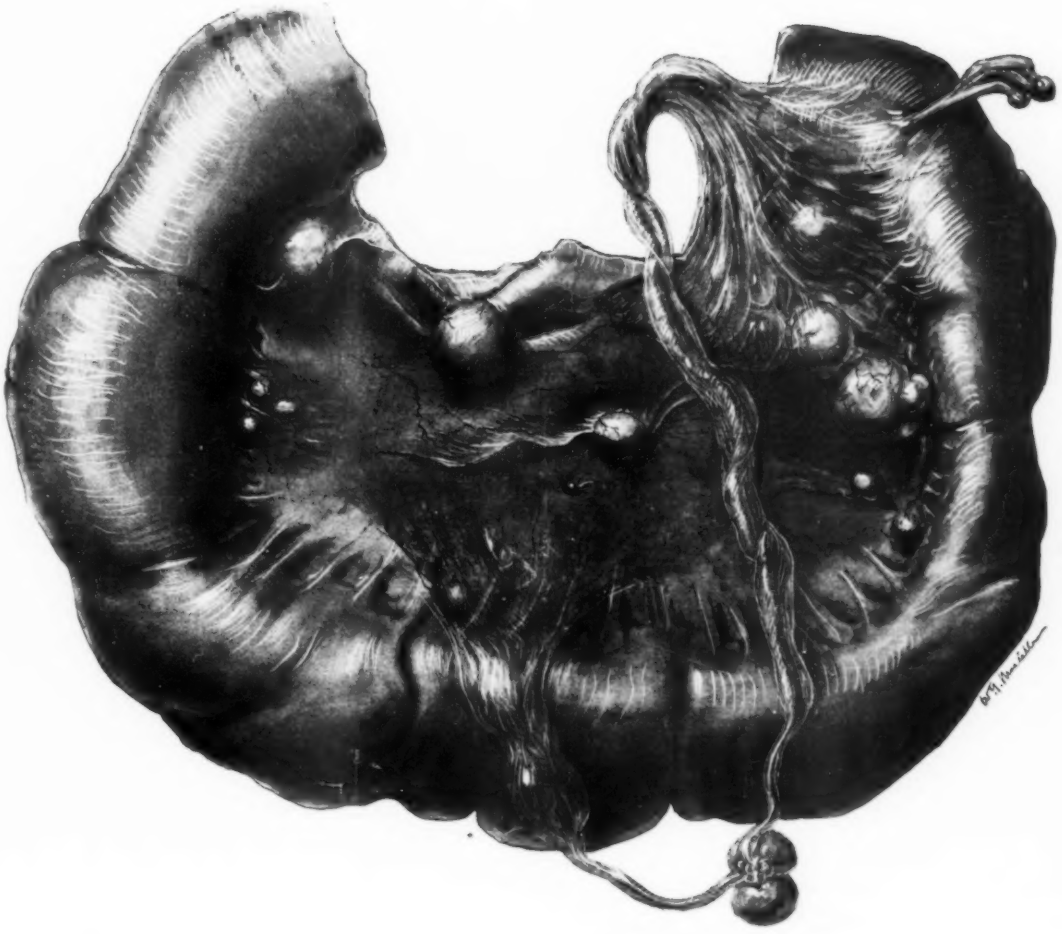
The spleen and liver were bound to the adjacent tissues by old adhesions which contained caseous masses—tubercle-like nodules could be seen in their substance on section.

The lungs were bound to the costal pleura by old adhesions —they were somewhat emphysematous and studded throughout with minute miliary tubercles—the bronchial glands were not involved.

Finally there was a tuberculous leptomeningitis, the pia mater over the pons cerebellum and cerebrum showing here and there a yellowish exudate with tubercles along the vessels.

Microscopically the nodules described in the liver, spleen lungs, etc., proved to have all the histological features of tubercles.

Sections were made through the peritoneal nodules so as to pass through the pedicle and the underlying tissue. The nodules were necrotic with the exception of the peripheral portion which had the characters of a tuberculous tissue consisting of irregularly arranged epithelioid cells and giant cells with very numerous lymphoid cells—externally a considerable mass of elongated connective tissue cells formed the capsular layer over which lay the peritoneal endothelium—this last, however, not being always seen in the sections. The architecture of the more central portions was sometimes preserved enough to indicate that they had arisen from the confluence of several smaller tubercles. Tubercle bacilli were to be found in great numbers in these masses and especially in the zone between the living and necrotic tissue in which the cells were degenerating and their nuclei becoming fragmented. The sessile nodules are embedded in an extremely vascular tissue which indeed spreads out wide of them and really forms also the pedicles of the pendulous nodules. Microscopically this tissue consists of a very loose connective tissue, in the interstices of which lie numerous round and plasma cells, but especially characterized by the presence of enormous numbers of very wide, thin-walled blood-vessels distended with blood. This vascular tissue passes up over the nodules, being fairly sharply marked off from the tuberculous tissue of their substance, and its presence explains the appearance of the wide area of congestion about each nodule, and the vessels described above as ascending to pass over the surface of the nodule. Sections through a pedicle show the same richly vascularized loose tissue in the wide clefts of which runs the fluid described macroscopically as appearing to be contained in a tube. Such tissue has, as Dr. Welch suggests, great resemblance to the tissue found newly formed on the dura mater in chronic internal hæmorrhagic pachymeningitis and he further tells me that he has observed it in the peritoneum and especially in the pelvic peritoneum of women without any associated tuberculosis. Indeed, as stated above, there are in this case many vascular areas, and even elongated pedicles without tubercles, and many long pedicles support tubercles of only insignificant size which can scarcely be thought of as having, by their mere weight, drawn out the peritoneal tissue into its present form. So although at first the mechanical effect of the weight of the tubercles seemed to offer a probable explanation of these curious formations, it now seems much more plausible to accept the suggestion of Dr. Welch and to consider the tubercle masses as formed, in part at least, in preexistent loose adhesions and strands of vascular new-formed connective tissue, not denying the importance of gravity in altering the appearance of these strands when the mass had reached any considerable size, or in some cases of initiating their elongation.



The drawing shows a portion of the intestine, natural size, with its mesentery, from which arise the sessile and pedunculated nodules described.

SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

FREDERICK H. VERHOEFF, M. D. A Case of Noma of the Auricles, Due to the Streptococcus Pyogenes, and its bearing on the Etiology of Noma in General.—*The Journal of the Boston Society of Medical Sciences*, Vol. V, pp. 465-478, May, 1901.

—— The Theory of the Vicarious Fovea Erroneous.—*The Ophthalmic Record*, June, 1901.

THOMAS B. FUTCHER, M. B. Syphilitic Fever, with a Report of Three Cases.—*New York Medical Journal*, June 22, 1901, p. 1065.

The importance of keeping in mind the fact that fever of obscure origin is occasionally due to syphilis is emphasized. With the onset of the secondary eruption there is nearly always an elevation of temperature. This "fever of invasion" is usually of a remittent type. Syphilitic fever, however, may also be either continuous or intermittent in type. It may occur as early as four weeks previous to the appearance of the secondary eruption or as a late tertiary manifestation.

Syphilitic fever is frequently mistaken for malaria, typhoid fever, tuberculosis, sepsis and occasionally rheumatic fever. Attention is drawn to the importance of making a careful examination of the long bones and viscera for evidences of tertiary lues in all cases of fever, of obscure origin, also of administering potassium iodide and mercury as a therapeutic test.

The first case reported had an intermittent fever commencing four weeks before the onset of the secondary eruption. It resembled closely the fever of aestivo-autumnal malaria. The second case had a fever simulating typhoid and its true character was determined by the finding of periosteal thickenings and by the cessation of the fever after administering potassium iodide. The third case had an intermittent fever resembling malaria twenty-nine years after the contraction of lues.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, April 15, 1901.

The meeting was called to order by the president, Dr. Welch, who introduced Dr. Harvey R. Gaylord of the New York State Pathological Institute at Buffalo, who spoke on The Parasite of Cancer, with Demonstrations.

DISCUSSION.

DR. WELCH.—Dr. Gaylord has brought before us something more than the mere description of the so-called cell-enclosures observed in hardened specimens of cancer. Of the enclosures hitherto described in preserved material the only ones which present anything like a definite organization and which, it seems to me, have not been altogether satisfactorily explained are the bodies first accurately described by Thoma and Sjöbring, and subsequently noted by most of those who have studied this subject. These bodies in English and American writings are often designated without much propriety as "Plimmer's bodies." No conclusive evidence that these bodies, still less that any other of the various enclosures, are parasites, has been furnished, and it now seems evident that no further progress in the search for parasites is likely to be made by the examination of hardened material with our present methods.

Under these circumstances it is important to turn to the examination of fresh material and to make attempts to cultivate parasitic organisms, provided such exist in cancer and other malignant tumors. This direction of study has therefore been followed in recent years by several investigators, and it is especially his results along these lines which Dr. Gaylord has reported to us this evening. As regards artificial cultures, it is certain that no forms of bacteria demonstrable by existing methods are directly concerned in the causation of cancer, and, notwithstanding the stronger claims made in behalf of Blastomycetes, I am glad to learn that Dr. Gaylord rejects these claims and takes a position in this regard opposed to that of San Felice, Roncali, Plimmer, Leopold, and others. He interprets as Protozoa the bodies which he regards as parasites.

Leaving out of consideration the occasional and accidental presence of cultivable bacteria and yeasts in cancer, I question whether what is called by Dr. Gaylord and other investigators as the cultivation of protozoa or of sporozoa from cancers should be so designated, and it does not appear that secondary cultures carried on from generation to generation have in any instance been secured.

There is not much agreement among the different observers either in the description or the interpretation of the various bodies regarded by them as parasites to be seen in fresh cancerous material or fluids, or in such material kept free from bacterial contamination, whether mixed with some cultural fluid or not. Dr. Gaylord lays especial emphasis upon the presence in cancers and other conditions of homogeneous, yellowish, spherical bodies resembling droplets of fat but without the usual reactions for fat, and he considers that he finds evidences of multiplication of these bodies and of their passing through a definite cycle of development which he describes. He is, I trust, prepared for a considerable degree of skepticism following this announcement of his results, and it is desirable that this should be the attitude of mind until we are in possession of more evidence than has yet been

furnished in favor of the parasitic hypothesis. It is, however, incumbent upon pathologists to make a careful study of all that can be seen in the microscopic examination of fresh, macerated, and preserved cancerous material, and whatever else may be the outcome of such studies, they will have furthered our knowledge of cellular degenerations and metamorphoses. Unless there are those present who on the basis of such study are prepared to discuss Dr. Gaylord's findings, it does not seem to me worth while to discuss them in detail.

Dr. Gaylord has presented an instance of multiple nodules in the lungs of an adeno-carcinomatous nature following the intravenous injection of cancerous ascitic fluid. With this exception and one or two more doubtful cases his experimental results, so far as the reproduction of malignant tumors is concerned, are, like those of other investigators in the same line, negative.

May 6, 1901.

The meeting was called to order by the President, Dr. Welch.

A Case of Pseudo-parasitism. Dr. Stiles.

Exhibition of Medical Cases. A Case of Charcot's Joints involving both Knees. Dr. Futcher.

This colored man is 68 years of age and manifested the first symptoms of tabes seven years ago in the form of lightning pains in both lower extremities. Two years later the right knee suddenly became swollen and inside of two weeks he noticed that the knee would give laterally whenever he attempted to bear his weight on it. Two weeks after the onset of the symptoms in the right knee the left knee became similarly involved. There was no pain at the onset, and there has been none throughout its course. In November, 1900, the right knee suppurated and was opened. The knee-joints, as you observe, now show the most marked deformity. The tibia on both sides is dislocated outwards on the femur, and there is very extensive lateral motion with hyper-extension of both knee-joints. The condition presented is that of Charcot's joint complicating tabes dorsalis.

Charcot first described the joint affections associated with tabes in 1868. The joints involved are usually the large ones and rarely, with the exception of those of the feet, are the small joints of the body affected. The joints of the lower extremities are more frequently affected than those of the upper. Chipault collected 268 cases of tabetic arthropathies, of which 120 were in the knee and 57 in hip joints. The character of the changes in the joints varies greatly with the type of the joints, as to whether they are ball-and-socket or hinge joints. In the first, such as the shoulder and hip, atrophy is more likely to occur than hypertrophy. In the knee, hypertrophic are more common than atrophic changes, and consequently there is more deformity. This complication of tabes often occurs comparatively early in the disease, and some observers say it may be the first symptom to attract the patient's attention. On the other hand some cases may come on very late in the affection.

The tropho-neuroses in tabes dorsalis are varied and divided by some into the osteopathies, arthropathies and osteo-arthropathies. To the osteopathies belong the spontaneous fractures in the long bones. The arthropathies include the cases with Charcot's joints. The osteo-arthropathies comprise those cases where the joints and bones are involved together, and in this group belong the vertebral lesions with kyphosis, as well as those cases of tabetic feet where the foot is foreshortened because of dislocation of the metatarsus backwards on the tarsus.

In the hypertrophic form of Charcot's joints the examination will show destruction of the cartilages with hypertrophy of the synovial fringes and thickening of the ends of the bone with rarefaction and consequent softening of the bone tissue. Occasionally the cartilages may be eburnated, but this is uncommon.

As to the treatment of tabetic joints there is very little that can be done to give permanent relief or improvement. In recent years an effort has been made to secure relief by excising the joints. We have had one case here in which excision was performed two years ago. The upper end of the tibia and the lower end of the femur were excised and the two extremities coapted, but at the last report union had not occurred. An interesting point was that the patient did not require an anæsthetic. He lay on the table perfectly conscious of what was going on. The bones were sawn through and the periarticular tissue removed without his experiencing the slightest pain. In the case before you the patient did not suffer any pain when the right knee-joint was opened.

Protozoic and Blastomycetic Dermatitis, with Lantern-slide Demonstrations and Exhibition of a Case. Dr. Gilchrist.

Discussion.

Dr. Stiles stated that when the cases first came up specimens of the parasites were submitted to prominent botanists, who concluded that they did not belong to the plant kingdom. After this opinion had been expressed by several well-known mycologists, he had reluctantly adopted it, and because of the resemblance of the parasite to *Coccidium*, and because of its method of reproduction, he had placed it in the sporozoa. He had advised Doctor Gilchrist to classify it temporarily in the microsporidia, chiefly because he did not see in what other group it could be placed, and not because he felt positive that it was a true microsporidium. The case at hand was an excellent example of the difficulty which frequently arises in determining whether a given organism is an animal or a plant.

May 20, 1901.

The meeting was called to order by the President, Dr. Welch.

Exhibition of Medical Cases. Dr. Osler.

Case 1.—This patient was admitted May 16, complain-

ing of stomach trouble. He is a laborer, aged 37—had jaundice when seven years old, which lasted about a year, and which is a point of interest in his history. Since then he noticed a yellow cast of the eyes whenever he felt badly, though we could not get a distinct history from him of permanent slight jaundice. There is no history of any acute illness of any moment. He has been a heavy eater and a drinker of beer from his sixteenth year, but has not used whisky. There is a suggestive history of lues.

The onset of his illness occurred May 7 with cramp-like pains on the right side, just under the ribs. He worked all that day and obtained relief from his pain by forced vomiting. A slight pain continued for several days but did not prevent his working. He lost ten or twelve pounds in weight before admission. He has had no fever and is a robust, rather healthy looking individual. In this light you do not especially notice the jaundice, but it is one of those instances where, having seen him in daylight and having his color fixed upon your mind, you can see that he is a little jaundiced. The point of special interest is the abdomen. You can readily see a slight fullness in the left umbilical region, and as he draws a deep breath you notice a distinct shadow. There is a marked difference between the infracostal grooves on the two sides. On palpation, there is in the left hypochondriac region and extending into the umbilical and epigastric regions a solid, firm tumor mass, the edge of which can be readily felt below and to the right. This mass is rounded, firm, very mobile and the hand can be passed behind it pushing it forward. Its edge is felt to be distinctly notched. There is no question at all that it is an enlarged spleen. It is a spleen of moderate size and not one of those that reaches almost to Poupart's ligament.

On examination the liver edge can not be felt on palpation at first, but on deep inspiration the edge descends and can be felt at the time of extreme inspiration. On percussion you notice a small area of hepatic flatness, not more than two fingers' breadth, and there is no ascites. He feels well and the jaundice and pain, which latter is better now, are the only two features of which he complains. His blood does not show any marked anemia; there is no leucocytosis and the hæmoglobin is 70%.

The interesting features are the presence of a very large spleen, with a very small liver, and jaundice without anemia. The case belongs to those interesting groups of which we have had a number of cases lately, illustrating the association of enlarged spleen with cirrhosis of the liver. There are several different conditions in which we may have splenomegaly with cirrhosis of the liver.

First, it is the rule in cirrhosis of the liver to have a big spleen and in a few rare instances in ordinary cirrhosis from alcohol the spleen reaches an enormous size. Some of you may recall a case we had in the hospital two years ago which we thought at first was very probably one of primary disease of the spleen, but which was shown later to be an enlarged spleen associated with a diseased liver.

Second, in all cases of hypertrophic cirrhosis, particularly those of the so-called Hanot type, the form that occurs in young children and persons without an alcoholic history, there is no ascites, but a permanent slight jaundice. Sometimes there is a very large spleen in these cases, a spleen equaling in size, or even exceeding the size of the liver. Many of you recall the two brothers (White) who were here for several years under observation, both having very large spleens. There is a good series of pictures in the last number of Guy's Hospital report with an article by Dr. Taylor particularly illustrating this form.

Third, there is an interesting group of cases, which we have been studying carefully during the last few years, in which there is a primary enlargement of the spleen associated with slight, but characteristic anæmia. Some of these cases show no anemia, but progressive enlargement of the spleen, sometimes without any other symptoms whatever. Such a patient may come, as some of our cases have, not complaining of the spleen, or of abdominal pain, but with hemorrhage from the stomach. In a certain number of those cases the liver has been atrophic. Banti, of Italy, has studied a number of them and the condition has been called Banti's disease. The anæmia is of the chlorotic type and as a late sequence there is cirrhosis of the liver. We have had two such cases, one of which was operated upon by Dr. Cushing for removal of the spleen which had been enlarged for eight or ten years. In that case there was a well marked ordinary cirrhosis with anemia. The second case was operated upon by Dr. Halsted a few weeks ago and here the liver was cirrhotic and the condition had lasted for six or eight years.

The case before us I think may be called a primitive splenomegaly with cirrhosis of the liver. He has been a beer drinker it is true, but you rarely get a marked cirrhosis in such people at this time of life and he has not the facies of ordinary cirrhosis.

CASE 2.—I wish to show this case for just one point. It is a case of scurvy with an unusual condition of the skin of the legs. In a few instances of scurvy there are very extensive subcutaneous hemorrhages particularly about the thigh and knees, and they may be so extensive and diffuse that the leg is in a sclerotic or scleremic condition. We have had one case in which the patient could not straighten his legs when he attempted to walk but simply shuffled them along. This man came in with swollen gums, with hemorrhages, and an enlarged knee. Aspiration showed bloody fluid in the knee-joint. The swelling is such that you can not pick up the skin at all on the hemorrhagic side. The condition is known as scorbutic scleroderma. The patient has only been in this country about a year, working at Locust Point, and has eaten practically nothing but meat and bread during that time.

DR. WELCH.—What is the value of treatment by extirpation of the spleen in Banti's disease?

DR. OSLER.—In Dr. Cushing's case, where the condition had lasted for eight or ten years, the spleen was removed, with complete recovery, and the patient has been well now nearly two years. In the second case that was operated upon,

the patient did very well for more than a week and then had a recurrence of the hemorrhages and died with a very profuse hemorrhage, which the post-mortem showed was from an œsophageal varix. The third case operated upon a few weeks ago by Dr. Halsted had a very large spleen with hemorrhages recurring for six years, and on four or five occasions the patient nearly bled to death. At the operation the splenic veins and arteries had been tied but in attempting to remove the adhesions between the spleen and the diaphragm an uncontrollable hemorrhage occurred and the patient died.

Drainage of the Bladder and Cystoscopic Examinations. Dr. Kelly.

Dr. Kelly spoke of drainage in bad cases of cystitis. Here attempts to wash out will be cut short on account of the pain. Dr. Kelly treats such cases by placing the patient in the knee-breast position and letting air into the bladder through the cystoscope. He then thrusts in a narrow-bladed, specially made knife, set at an angle with the handle, and draws it downward towards the urethra, leaving a free opening into the bladder for escape of urine. Dr. Kelly urged the importance of making topical examination of the bladder before commencing treatment in cases of apparent cystitis. He had had cases which had been treated elsewhere for a length of time for cystitis, when on using the cystoscope a stone was seen, and in its removal the symptoms disappeared. He spoke also of peculiar cases of pregnancy which he does not understand. One part of the uterus softens down and the rest remains rigid; the softened part may bulge. In his case it was mostly towards the patient's right. The patient was the wife of a physician from Iowa. He was advised to let it alone and returned home, where his wife had a normal labor. In another case, the wife of an army surgeon, the abdomen was opened and the right upper horn of the uterus found to be softened. The patient later aborted per vias naturales. In a third case exactly the same condition was found. Dr. Kelly would call it "apical pregnancy," and it is liable to be mistaken for extrauterine pregnancy.

Observations upon Smallpox. Dr. Otley J. Porter, of Columbia, Tenn.

Dr. Porter described an epidemic that has recently prevailed in that section of Tennessee in which he lives. For a time the diagnosis was in dispute, some regarding it as chicken-pox, others as a new sort of eruption, "the bumps," and a few diagnosticating true smallpox. Meanwhile, in the uncertainty there was no efficient action or isolation, and the disease spread until there were 1000 cases. Dr. Porter exhibited casts of the eruption and threw pictures on the screen, showing that the disease differed in no way from the smallpox of the text-books, there being cases of hemorrhagic, confluent, semi-confluent and discrete smallpox, as in other epidemics. The mortality also was the same, all the hemorrhagic cases (5 or 6) dying; 40 per cent of the confluent, and 10 to 15 per cent of the discrete. Old persons over 75, pregnant women and infants under 12 months are usually exempted from the need of vaccination, but none need it more than these persons. In the 1000 cases there were some 15 of the disease in the fetus in utero, several of which Dr. Porter had himself delivered.

Discussion.

Dr. Fulton.—It is very fortunate for the State of Maryland that a dispute about the diagnosis of this disease has not arisen here. I doubt whether anybody would have made and defended the true diagnosis in the way it has been done in Tennessee. Some of the big wigs in that State were on the side of chicken-pox in that controversy. Before engaging in a controversy with a man who collects evidence so carefully and presents it so vividly, one must be very sure that he is right, for there are only two alternatives, to be right or to run. In Tennessee the big wigs ran, as wise men should in such a predicament.

It is not surprising that errors of diagnosis have been frequent in the history of the smallpox epidemic now prevailing in the United States. The disease itself departs widely from the text-book descriptions, though not more widely than typhoid fever does; and these variations are no less manifest in its epidemic characteristics than in the individual cases. The medical student of to-day has no chance to observe the disease, and has therefore no mental picture of the disease other than that gained from the text-books. Comparatively few physicians under 50 have seen the disease, while the older men remember the disease by the more impressive characteristics of its appearance years ago.

Besides, there are fundamental reasons why the diagnosis of the eruptive fevers should sometimes be difficult. Knowing as we all do in what varying degrees the animal body reacts to the infections, it seems strange that medical men expect reactions to the same organism to be always similar in kind. Every eruptive fever is known by its peculiar dermatitis. Fortunately the appearances of the skin in measles, scarlet-fever, chicken-pox, and smallpox are usually characteristic enough, in conjunction with other data, to lead to correct diagnosis. Chicken-pox and smallpox are, however, strikingly alike at times, and in the present epidemic this is particularly true. As one's experience grows, one approaches the problem of diagnosis in each new isolated case with increasing diffidence. Watching the whole evolution of the lesion, one should not go astray, but this deliberation about diagnosis does not satisfy the demands of public safety, nor the clamor of private interests, when smallpox is suspected. It will be remembered that Hebra taught that variola and varicella were one disease, and some of his pupils still hold that doctrine.

The signs of the times are but slightly hopeful that we shall soon have identified the contagium vivum of smallpox, and the controversies about diagnosis will not wholly disappear until that comes about. Two recent communications upon this subject are of interest. M. Funck, of Brussels, describes what he calls the sporidium vaccinale, which he

thinks he recognizes in three stages. 1st, small, spherical, highly refracting bodies of a green color, having slow movements, and varying in size from 2 to 10 micromillimeters; 2nd, collections of smaller refracting spheres enclosed in a sort of capsule; and 3d, morula masses 25 to 30 micromillimeters in size, which he thinks are spore cysts. He studies the sporidium by the hanging drop method, in a warm, moist chamber. The sporidia, he says, attach themselves to the cover-slip, while the other elements fall toward the apex of the drop. Funck also claims to cultivate the organism. He spreads vaccine lymph on ordinary agar plates, which are inoculated for 24 hours. The sporoblasts are, after incubation, recognized under a low power. He picks these out with a platinum needle hammered into a sort of spatula. With this tool he transfers the sporoblasts to bouillon, and the resulting emulsion, he says, produces typical vaccinia when inoculated into a calf. He gets the same organism from the lesions of variola.

A second and more hopeful communication is that of Copeman, who described in 1896 an organism that he was able to cultivate from vaccine lymph, using the hen's egg as a medium. His experiments failed frequently, and recently he has come to the conclusion that his failures were due to his working with eggs that were not fertile. He insures this now by incubating his eggs for a short time, using only those which prove fertile. He also used the collodion capsule method of inoculation. Bouillon cultures of glycerinated vaccine enclosed in collodion capsules are placed in the peritoneal cavity of the dog or the rabbit, and after 14 days are removed, when stained films show zooglea masses, made up apparently of spores. With the bouillon Copeman produces vaccinia in the calf. Bouillon cultures in collodion sacs, similarly inoculated, are put in plain bouillon test tubes and kept in the thermostat for the same period. The contents of these capsules, used as controls, do not produce vaccinia in the calf.

I should like to use the lantern for a few illustrations of smallpox cases recently observed in Maryland (Illustrations).

DR. SMITH, Minneapolis.—I would like to speak of the results of the epidemic in our city. We have been passing through an epidemic of this disease and this exhibition of Dr. Porter's has been very interesting to me because one of our physicians has been doing similar work. His casts, however, were made of wax and were colored. They were presented to the University of Minnesota Medical Department and are being used now to show the students the picture of a disease they will not see in life.

We met with considerable difficulty at first in the diagnosis and the city had fifty cases before the health commissioner would recognize it. If it had not been for the very efficient work of Dr. Bracken, the secretary of our State Board of Health, the epidemic would have been much more dangerous than it was. He worked night and day to suppress it and at times quarantined whole sections of the State. We could trace the disease to two women who came to the city infected. One of the peculiarities noticed at first was the appearance of a bracelet around the wrists and of hard nodules in the palm of the hands. We knew those were not chicken-pox cases, and wherever we found itching or eruption on the hands, we quarantined that person.

As to the question of vaccination

Closing Discussion of Dr. Porter's paper.

DR. PORTER.—In regard to the remark that it is left for the future to say whether we have had a modified form of smallpox in this epidemic, I think one point may be mentioned to prove that this was not a modified form. The different types of the disease were interchangeable even in the same family—for instance in one family that I knew of, the daughter had a mild attack of the discrete form. The mother, who refused vaccination, contracted the disease and died of the malignant hemorrhagic type, while her husband developed the ordinary confluent form. Assuming that we have a modified form, or an attenuated microorganism, it is difficult to understand these cases.

In regard to the vaccination of cases that have recovered from smallpox, I made that test in twenty-five cases and did not get a take in any instance. I got two septic sores, but they were not the typical vaccine sores. Other gentlemen made the same experiments, and as far as I know all failed, but of course it is not impossible that it might happen.

Adjournment.

June 3, 1901.

Fibrinous Bronchitis. DR. BETTMANN.

(Paper to appear in *The American Journal of the Medical Sciences*).

Maggie Scott, colored, female, married, age 22, mother of two children, labors normal, no history of tuberculosis; menstrual history normal. The patient was admitted to the Maternity Ward of the Johns Hopkins Hospital August 20, 1900, with the following history: At various times throughout the past six years she has suffered from attacks of cough, pain, respiratory distress, and profuse expectoration of branching casts usually in the autumn. Although she has gradually emaciated during the past three years she has been well during the intervals between the attacks, which have had no relation to her pregnancies.

Her present attacks occurred thirteen days after normal labor, and were characterized by a slight bronchitis, extreme respiratory distress, a rise of temperature to 102°, and a cough which was relieved by the expectoration of casts. She had two similar attacks subsequently with an interval of eleven days between them. She left the hospital in spite of the protests of her physician four days after her last attack, when she still had some slight evening temperature (rarely 101°). She remained in Baltimore three weeks and had similar attacks during that period, and two weeks later she died in Virginia. No data as to the cause of death were obtainable. It should be added that the possibility of a puerperal infection was excluded by the absence of local signs and the general good condition of the patient. There was intense dyspnœa and severe coughing during the attacks, with pain

in the left side of the chest. There were present râles of all types, impaired resonance, and a small area of tubular breathing in the right lower lobe during the first attack. In the intervals between the first and second attacks an area of impaired resonance and impaired breath sounds were detected in the left axillary region. There was no leucocytosis; differential count normal; no albumin in the urine.

CASTS.—During the two most severe attacks the patient coughed up two casts 10 cm. long which showed branching down to the 10th or 12th degree; other smaller casts were coughed up in the interval. These, on cross section, showed an outer laminated "skin," inclosing separate whirls and complete cylinders. Air vesicles were seen throughout the casts. Little intumescentia were seen at the ends of the finer branchings. The use of Weigert's fibrin stain showed surprisingly little fibrin distributed in the outer layer of the casts. Hematoxylin and eosin stains showed mucin and a substance taking the eosin stain deeply but not staining with the Weigert stain. This substance, from its staining reactions, did not seem to be mucin or fibrin but contained the fibrillae that retained the fibrin stain. The cells are mostly small mononuclear leucocytes; a few eosinophiles are present; no polynuclears. There were no Charcot-Leyden crystals. Throughout the casts were irregularly round bodies, the size of a red blood corpuscle, staining with the Weigert stain, with the tubercle stain and with eosin (eosin methyl-blue method). These apparently had a double contoured shell, from which, in places, an inner granular and vacuolated protoplasm seemed to have shrunk away. They reminded one of the blastomyces which Gilchrist has described in dermatitis. Bacteriologically the casts showed staphylococci and streptococci on the outer side of the outside layer. Occasional organisms were seen in the inner portion of the cast. Cultures taken under antiseptic precautions from the interior of the cast showed the presence of staphylococcus aureus, streptococcus pyogenes. There were no pneumococci and no diphtheria bacilli.

An analysis was then given of Lebert's paper in Deutsches Arch. klin. Med., 1869. To this was added an analysis of all cases of fibrinous bronchitis in French, English and German literature since 1869.

The author grouped the cases reviewed into 9 groups for purposes of description: I. and II. Chronic and acute cases with expectoration of branching casts, 27 and 15 cases respectively. III. Cases in which branching casts were not expectorated but were found at autopsy, 6. IV. Cases in which the casts expectorated showed no dichotomous branchings, 11. V. and VI. Expectoration of branching casts in the course of organic heart disease and pulmonary tuberculosis, 10 and 14 cases respectively. VII. Expectoration of small casts often not branching in asthma, 5 cases. VIII. Formation of casts in bronchi following thoracentesis, 4 cases. IX. Poorly reported cases, 6.

The author demonstrated sections of casts in various stains under the microscope as well as hardened specimens.

The Life History of Drepanidium. HERBERT E. DURHAM and the late WALTER MYERS. (Liverpool Yellow Fever Commission.)

The smaller kind of toad found at Pará, Brazil, was found to be infested by endoglobular blood parasites. In all the specimens examined two forms of parasite were found: (1) with highly refractile protoplasm and granules, and of more or less irregular shape, and (2) with pale protoplasm and elongate and fusiform in shape. The former correspond to the "Dactylosoma" described by Labbé (Archives de Zoologie Expérimentale ——? 1895 ———) and the latter to the form known as Drepanidium; both of these two forms were always present, though in varying proportion. The highly refractile form, when fully developed, is of an irregular amœboid shape or somewhat like a bent blunt club; segmentation or sporulating forms in a fan-shaped arrangement are occasionally met with, these often appeared to be referable to a tripartite division whereby each of three lobes gives origin to three small bodies. We had no evidence that the adult refractile forms ever leave the host-corpuscle, the nucleus of which, however, is dislocated. The *pale form* lies alongside the nucleus of the corpuscle, which is not displaced. When mature it leaves the corpuscle in specimens of shed living blood, and swims freely with its narrower extremity forwards. We are doubtful whether these forms ever leave the corpuscle WITHIN the body of the toad, for in specimens of blood which had been fixed with weakly sublimated saline solution and centrifugalized, no free forms could be found; thereby contrasting with similar specimens made without the fixing agent in which hardly a single endoglobular individual could be found. The multiplication of these forms takes place chiefly in the liver (less in the spleen, and less still in sternal marrow), where cysts about 10 μ in diameter containing immature pale forms may be found in great abundance. The mode of entry of these into individual red blood corpuscles was not observed.

The toads were mostly infested by a species of tick: Examination of the contents of ticks showed a graduated series of cysts up to about 60 μ in diameter. The cysts consist of a thin hyaline membrane (as seen in ruptured or empty specimens) and fragmented protoplasmic masses lying within it; usually also there are two or three larger protoplasmic masses attached by bridles to the periphery. The small fragmented masses correspond in appearance to small, actively motile amœboid bodies, found in the contents of the tick and the plasma and corpuscles of the toad. Conditions suggestive of conjugation of the free drepanidia have been seen in the tick, where their movements are more rapid than in plain films of toad's blood. The examination of cattle- and dog-ticks failed to reveal cysts similar to those above mentioned, and we presumed that these were a stage of development of the blood parasites of the toad. On this conception the cycle may be compared to that of the malaria parasite in its development in circulating blood, organs (marrow and spleen) and in the anopheles group of gnats.

Asexual cycle within blood corpuscle of toad ("Dactylosoma").

Sexual cycle multiplication in organs (liver) of toad: leaves blood corpuscles ("Drepanidium") within tick: probable conjugation resulting in formation of cysts: which give rise to minute amœboid spores.

Owing to the length of time of attachment of the tick many stages are seen contemporaneously. From lack of material it was not possible to make infection experiments upon uninfected toads.

NOTES ON NEW BOOKS.

The Hygiene of Transmissible Diseases: their Causation, Modes of Dissemination and Methods of Prevention. By A. C. ABBOTT, M. D., Professor of Hygiene and Bacteriology, University of Pennsylvania. Third Edition. Revised and Enlarged. Octavo, 351 pages, with numerous illustrations. (*Philadelphia and London: W. B. Saunders & Company. Cloth*, $2.50 *net*.)

A review of the first edition of this excellent work appeared in the BULLETIN for March 1900. Since that time investigations upon the modes of dissemination of certain of the specific infections have been conspicuously active, and through them much new light has been shed upon the transmission of diseases and many novel suggestions have been made; especially is this the case with regard to the roles of insects and rodents as disseminating factors. Wherever practicable, these views have been embodied and discussed in the present edition. The resume of our latest knowledge of malarial fever is especially good. In the treatment of the subject one feels that the author has been hampered by what he had previously written, and that the new and the old are not wholly harmonious. It is to be hoped that in the next edition the state of our knowledge of malarial disorders may be so complete as to justify the rewriting of the whole section. The sections on Yellow Fever, Plague and Dysentery are most valuable. The book is in every way more satisfactory than was the first edition.

We notice one or two typographical errors, as e. g., on page 214 *Koplic* twice for Koplik, page 270 *Clements* for Clement, and page 216 "periodic recurrence *or* paroxysms" for of paroxysms.

Golden Rules of Hygiene. By F. J. WALDO, M. A., M. D. (Cantab.), D. P. H., Barrister-at-Law. Golden Rule Series No. X. (*Bristol: John Wright & Co.*)

This concise little book gives very sensible suggestions as to Air, Water, Disposal of Refuse, Food and Infectious Diseases. The rules are well arranged and easy of reference.

Essentials of Refraction and of Diseases of the Eye. By EDWARD JACKSON, A. M., M. D., Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic. Third Edition, Revised and Enlarged. 12mo, 261 pages, 82 illustrations. (*Philadelphia and London: W. B. Saunders & Co.*, 1901. *Cloth*, $1.00 *net*.)

In this edition the work has been carefully revised and very much enlarged, the contents being more complete and more symmetrical than was possible in the earlier editions. The injuries of the eye by traumation, and the ocular symptoms and lesions of general diseases have now been given a consideration proportioned to the great importance they assume in the work of the general practitioner. There has been added also an account of the application of the tests of vision required in the army, navy and railway service.

This work has long since proved its usefulness to the beginner in ophthalmic work, to the student, and to the busy practitioner. The entire ground is covered, and the points that most need careful elucidation are made clear and easy.

Burdett's Hospitals and Charities, 1901. Being the Year Book of Philanthropy and the Hospital Annual. By Sir HENRY BURDETT, K. C. B. (*London: The Scientific Press (Limited), 28 & 29 Southampton Street, Strand, W. C.; New York: Charles C. Scribner's Sons.*)

We are glad to welcome the twelfth year of the above publication. The manual is an invaluable aid to all persons who have to do with charitable work, and the author has done more to systematize hospital methods in this country and in Europe than any other single person. The volume contains much interesting reading, some of which commends itself especially to one who lives in America and is familiar with the freeness and liberality of the hospitals of the United States. It is interesting to notice that there are seven hospitals in London where the patients are required to supply their own tea, sugar, and butter; thirty-three hospitals where patients must supply a change of bed-linen; and nineteen hospitals where patients are under the necessity of paying extra for laundry work. At twenty-two hospitals patients are required to provide more or less of the following articles: towels, slippers, knife, fork and spoon, brush and comb, soap, plate, cup and saucer; but it is gratifying to know that there are twenty-two hospitals where patients are not required to furnish anything. In the Provinces the number of hospitals requiring miscellaneous articles to be supplied is very great. It would seem in fact from reading the list, that poor patients are obliged to supply an almost impossible number of requisites. The author's very commendable reasons for furnishing the above list are: "First of all, it is desirable, in the best interests of the institutions and of those whom they treat, that the in-patients should be required to provide nothing. Discipline, cleanliness, and due regard to the circumstances of the poor, all demand the abolition of the old-fashioned practice of allowing patients to provide even personal linen, much less to permit them to defray the cost of their own washing. Secondly, any one who has a knowledge of hospital accounts will readily recognize the considerable reduction which there ought to be in the cost per bed, in the case of hospitals which require the in-patients to supply themselves with linen and groceries."

The book is admirably printed and well arranged. It is surprising that it has been possible to secure so much information respecting American hospitals and training schools for nurses.

Practical Surgery: A work for the General Practitioner. By NICHOLAS SENN, M. D., Ph. D., LL. D., Professor of Surgery, Rush Medical College, Chicago. Handsome octavo volume of 1133 pages, with 650 illustrations, many in colors. (*Philadelphia and London: W. B. Saunders & Co., 1901. Cloth*, $6.00 *net*.)

Like all other practical works representing the surgical methods of an operator who has had many years' experience this book of Professor Senn is destined to be of great service to the profession at large. It does not claim to be a systematic treatise on surgery, but simply a statement of those things which the every-day practitioner is likely to meet with in the practice of surgery, either in the city or country. It contains an account of Professor Senn's experience with gun-shot wounds and injuries in the Spanish war and also in the

Turkish war. His treatment of gun-shot wounds is eminently sensible. He speaks of the necessity of a complete immobilization of the injured parts and of perfect antiseptic work in connection with all first dressings. It is gratifying to know that by means of first aid packages and other modern devices, the dreadful aspects of military surgery a hundred years ago are completely changed. He deplores the failure of laparotomy performed on the field for gun-shot wounds of the intestines, although it is not strange that such surgery should be ineffectual.

The chapters on fracture are also extremely interesting, especially his treatment of fractures of the hip. We are glad to notice that he condemns absolutely the ambulatory treatment of compound fractures.

At first glance it might seem strange that he does not refer to gall-bladder operations, operations for the relief of breast cancer and operations for the removal of the Gesserian ganglion but it should *not* be forgotten that the treatise is for the general practitioner and surgeon rather than for the surgeon who is in a position to do special operations. The operations alluded to require a degree of expert knowledge which can only be acquired after very long practice. Hence, wherever practicable, it would seem extremely judicious to reserve such specialized operations for specialists in private or general hospitals who do them frequently.

The book is beautifully printed and well gotten up. A few typographical errors are to be noticed, especially in the names of individuals.

An interesting feature of the book is the attempt to emphasize important points by the use of italics. Although one is generally opposed to the wholesale use of italics in journal articles, in the present instance their employment seems judicious and helpful to the general reader.

Principles of Surgery: By N. Senn, M. D., Ph. D., LL. D., Professor of Surgery in Rush Medical College in affiliation with the University of Chicago; Professional Lecturer on Military Surgery in the University of Chicago; Attending Surgeon to the Presbyterian Hospital; Surgeon-in-Chief to St. Joseph's Hospital; Surgeon-General of Illinois; late Lieutenant-Colonel of United States Volunteers and Chief of the Operating Staff with the Army in the Field during the Spanish-American War. Third Edition Thoroughly Revised. With 230 wood engravings, half tones and Colored illustrations., (*Philadelphia and Chicago: F. A. Davis Company, Publishers, 1901.*)

This work is a pioneer in its class in this country. Like the other writings which have come to us from the author, it shows a complete mastery of the methods of imparting interest to difficult subjects.

The title might just as well have been "Surgical Pathology" for this is the main feature of the work, which one might infer from the title "Principles of Surgery." Practical details in treatment are not wanting by any means. They are terse as a rule and where diagrams can take the place of wordy details they are inserted. The illustrations are numerous and clear, the skiagraphs making a valuable addition to a work on practical surgery.

Usually the author takes the broadest scientific view of the matter and gives us the most recent knowledge on all subjects with which he deals. After describing erysipelas at some length he states very positively "the streptococcus of erysipelas never produces suppuration." It is on bone tuberculosis that his clearing out is of particular value. He is liberal in his views, not holding us fast to any one line of thought unless there is unmistakable scientific proof for his way of thinking. Owing to the arrangement of the subjects it is difficult to locate the practical surgical details until after having read the entire book.

Some surgical points on bone surgery are to be found under osteomyelitis, others under tuberculosis of bone or joints; again others under abscess.

The treatment of paronychia and tendo-vaginitis is described under suppuration. Under healing of wounds is given what he has to say on technique and sutures. After exhorting to absolute asepsis, the author deals with haemostasis, suturing and physiological rest. He deals with regeneration of different tissues, describes tenorrhaphy, nerve suture and healing of wounds of organs.

Degeneration is as thoroughly described as in text-books on pathology.

As inflammation is divided into acute and chronic forms, so is suppuration described as acute and chronic.

The pyogenic organisms and all other microorganisms known to the surgeon are thoroughly described along with something of the history of their discovery.

There are many little points valuable to the practicing physician which are only found after careful reading. The significance of pain is described under inflammation. It is made of diagnostic value in periostitis and syphilitic bone disease.

Inflammation, one of the most difficult subjects to treat, is very nicely dealt with from both the scientific and practical sides. Senn states that "inflammation is always caused by the presence of one or more kinds of pathogenic microbes" and must be sharply distinguished from the regenerative processes. The treatment of the subject of ulceration is clearer and more practical than in most text-books on surgery. Senn allows for varying local and general conditions, tissues involved and microorganisms present in the classification of ulcers. He thinks that all ulcers are caused and maintained by pathogenic microorganisms.

The treatment of the subject "tuberculosis" is excellent. It is most comprehensive and, considering the limits of the book, it is very thorough. One of the chief characteristics of the book is the direct manner in which the lessons are taught.

Senn's book is a natural outgrowth of the times. It comes at a transitional period for students who are learning to combine the science and practice of medicine more intelligently than in former days. It is a book which should be at the hand of every surgeon.

S. M. C.

Atlas of the Nervous System, including an Epitome of the Anatomy, Pathology, and Treatment. By Dr. Christfried Jakob. With a preface by Prof. Ad. v. Strumpell, Edited by Edward D. Fisher, M D. With 112 Colored Lithographic Figures and 139 other Illustrations, many of them in Colors. (*Philadelphia and London: W. B. Saunders & Co., 1901.*)

The present Atlas is designed to give students and physicians an adequate conception of the relations of various parts of the nervous system to each other. The illustrations are unusually good and some of them are extremely graphic. Those relating especially to the cortex of the brain are works of art. The principal value of the book, of course, is in its appeal to the eye, and the endeavor which it successfully makes to illustrate adequately the subject represented. The portion of the book which relates to general pathology and treatment is rather disappointing, because of the great brevity which is necessary from an effort to compress the material into the space allowed. The book, however, is creditable in every respect. It is well printed and attractively bound.

A System of Physiologic Therapeutics. A practical exposition of the methods, other than drug-giving, useful in the treatment of the sick. Edited by SOLOMON SOLIS COHEN, A. M., M. D., Professor of Medicine in the Philadelphia Polyclinic, etc. Vol. II. Electrotherapy. By GEORGE W. JACOBY, M. D., Consulting Neurologist to the German Hospital, New York City, etc. In two Books, Book II: Diagnosis, Therapeutics. Illustrated. (*Published by P. Blakiston's Son & Co., 1012 Walnut St., Philadelphia, Pa. Price eleven volumes, $22 net.*)

This volume, like all other honestly written books on electrotherapy, is in some respects disappointing. The gist of it seems to be that electricity, after its use as a diagnostic agent is eliminated, is mainly serviceable by way of mental suggestion and for its psychic effect. The sections of the work which treat of electrophysiology and electropathology and of electrodiagnosis and electroprognosis, seem especially valuable, and are worthy of great praise for their clearness and conciseness. Methods of examination are carefully given and charts and diagrams render very clear the proper points for the electrization of muscles and groups of muscles in every part of the body.

When we come to the sections on electrotherapy we learn that electricity acts through a combination of exciting electrotonic, chemical (and electrolytic) cataphoric and psychic or suggestive actions, and that "how great an effect is to be ascribed to each individual action has not been and cannot be demonstrated" . . . "That however, psychic influence does form a very large part of the therapeutically beneficial action of electricity is undoubted, because the channels through which it may act are manifold." All the other effects may "abide" but the greatest of these is the psychic or suggestive effect of electricity. This confession helps to explain why electricity has invariably been the right hand of the quack and charlatan, but it also tends to discourage the student of medicine who has lived in hope that, sooner or later, order in electrotherapeutics would emerge from chaos, and electricity as a remedy for the cure of disease, would take a fixed and dependable place in the medical armamentarium.

The book, as a whole, is a discriminating one and must do good by placing electrotherapy upon a less pretentious and more scientific basis. It should be diligently studied by all who use electricity as a therapeutic agent.

The American Illustrated Medical Dictionary. A new and complete Dictionary of the terms used in Medicine, Surgery, Dentistry, Pharmacy, Chemistry and Kindred Branches, with their pronunciation, derivation and definition, including much collateral information of an encyclopedic character. By W. A. NEWMAN DORLAND, A. M., M. D., Fellow American Academy of Medicine. With numerous illustrations and 24 colored plates. (*Philadelphia and London: W. B. Saunders & Company, 1900.*)

In shape, size, binding and typography this volume is all that can be desired for convenience and handy reference. The print is compact and the sizes of type are so well adjusted to each other, the page does not fatigue the eye. The binding in limp leather renders the book easy to handle. The definitions in some instances are open to criticism, e. g. "Paranoia, Mental aberration or eccentricity with perversion of the will, in pronounced cases it is a form of insanity." As a matter of fact paranoia is a form of mental disease and characterized by systematized delusions arising primarily, that is without antecedent excitement or depression. The definition of B. aërogenes Capsulatus is also faulty, "a pathogenic form from the blood-vessels in a case of thoracic aneurism." Whatever may have been the disease in which this bacillus was first found it has been met with since in many other situations besides the blood of a thoracic aneurism.

There are also some omissions, as e. g., Dementia precox cannot be found under the head of dementia.

The illustrations are good and many of them give valuable aid to the text. The book can be commended as convenient and useful.

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